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ЭКОНОМИКАЛЫҚ ТИІМДІЛІК ЖӘНЕ ЖАСАНДЫ ИНТЕЛЛЕКТТІ АУЫЛ ШАРУАШЫЛЫҒЫНДА ҚОЛДАНУ ӘЛЕУЕТІ: ЖАҺАНДЫҚ ҮРДІСТЕР МЕН ҚАЗАҚСТАН ҮШІН МҮМКІНДІКТЕР

Демографиялық қысымның, климаттың өзгеруінің, ресурстардың сарқылуының және азық-түлік қауіпсіздігіне төнетін қауіптердің өсіп келе жатқан жаһандық сын-қатерлері жағдайында ауыл шаруашылығы тұрақты дамудың негізгі буынына айналуда. Бұл мақалада халықаралық трендтер мен қазақстандық контекстке баса назар аудара отырып, аграрлық салада жасанды интеллект (AI) технологияларын қолданудың экономикалық тиімділігі мен әлеуетін бағалауға арналған. Өнімділікті арттыру, шығындарды оңтайландыру, климаттық тәуекелдерді болжау, логистиканы жақсарту және өсімдіктер мен жануарлар ауруларын ерте анықтау үшін AI мүмкіндіктері талданды. Шетелдік кейстер мен отандық бастамаларды талдау негізінде өсімдік шаруашылығында, мал шаруашылығында және агромониторингте жасанды интеллект енгізу тәжірибелері қарастырылды.

Мақалада 2009–2023 жылдар кезеңінде Қазақстанның агросекторының цифрлық жетілуінің макроэкономикалық, инновациялық және институционалдық индикаторларына салыстырмалы және корреляциялық талдау жүргізілді. Сонымен қатар ауыл шаруашылығында жасанды интеллекті ауқымды енгізу үшін стратегиялық бағыттарды ұсынады: мемлекеттік қолдауды күшейту, инновациялық инфрақұрылымды дамыту, кадрлық даярлық және агростатистиканы цифрландыру.

Осылайша, жасанды интеллект Қазақстанның ауыл шаруашылығының тиімділігін, тұрақтылығын және технологиялық егемендігін арттырудың көпсалалы драйвері ретінде қарастырылады. Алынған нәтижелер АӨК цифрлық трансформациясының кешенді моделін қалыптастыру үшін аналитикалық база ретінде қызмет етеді.

Түйін сөздер: жасанды интеллект, ауыл шаруашылығы, цифрландыру, азық-түлік қауіпсіздігі, ауыл шаруашылығындағы инновациялар.

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Economic efficiency and prospects for the application of artificial intelligence in agriculture: global trends and opportunities for Kazakhstan

In the context of increasing global challenges of demographic pressure, climate change, resource depletion and threats to food security, agriculture is becoming a key element of sustainable development. This article is devoted to assessing the economic efficiency and potential of using artificial intelligence (AI) technologies in the agricultural sector, with an emphasis on international trends and the Kazakh context. The possibilities of AI for increasing yields, optimizing costs, predicting climate risks, improving logistics, and early detection of plant and animal diseases are analyzed. Based on the analysis of foreign cases and domestic initiatives, the practices of introducing AI in crop production, animal husbandry and agromonitoring are considered.

The study provides a comparative and correlation analysis of macroeconomic, innovative and institutional indicators of the digital maturity of the agricultural sector in Kazakhstan for the period 2009-2023. Key barriers have been identified: low investment in R&D, fragmented scientific infrastructure, and limited institutional support. The article suggests strategic directions for the large-scale implementation of AI in agriculture: strengthening government support, developing innovative infrastructure, personnel training and digitalization of agricultural statistics.

Thus, AI is considered as a multidisciplinary driver for improving the efficiency, sustainability and technological sovereignty of agriculture in Kazakhstan. The obtained results serve as an analytical basis for the formation of a comprehensive model of the digital transformation of agriculture.

Keywords: artificial intelligence, agriculture, food security, digital transformation, innovation in agriculture.

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Экономическая эффективность и перспективы применения искусственного интеллекта в сельском хозяйстве: мировые тенденции и возможности для Казахстана

В условиях нарастающих глобальных вызовов демографического давления, климатических изменений, истощения ресурсов и угроз продовольственной безопасности сельское хозяйство становится ключевым звеном устойчивого развития. Настоящая статья посвящена оценке экономической эффективности и потенциала применения технологий искусственного интеллекта (ИИ) в аграрной отрасли с акцентом на международные тренды и казахстанский контекст. Проанализированы возможности ИИ для повышения урожайности, оптимизации затрат, прогнозирования климатических рисков, улучшения логистики и раннего выявления болезней растений и животных. На основе анализа зарубежных кейсов и отечественных инициатив рассмотрены практики внедрения ИИ в растениеводстве, животноводстве и агромониторинге.

В исследовании проведен сравнительный и корреляционный анализ макроэкономических, инновационных и институциональных индикаторов цифровой зрелости агросектора Казахстана за период 2009–2023 гг. Выявлены ключевые барьеры: низкий уровень инвестиций в НИОКР, фрагментарность научной инфраструктуры и ограниченная институциональная поддержка. Статья предлагает стратегические направления для масштабного внедрения ИИ в сельском хозяйстве: усиление государственной поддержки, развитие инновационной инфраструктуры, кадровая подготовка и цифровизация агростатистики.

Таким образом, ИИ рассматривается как мультидисциплинарный драйвер повышения эффективности, устойчивости и технологического суверенитета сельского хозяйства Казахстана. Полученные результаты служат аналитической базой для формирования комплексной модели цифровой трансформации АПК.

Ключевые слова: искусственный интеллект, цифровизация агросектора, продовольственная безопасность, инновации, инновации в сельском хозяйстве.

Кіріспе

Соңғы онжылдықтарда жасанды интеллект (AI) экономиканың негізгі секторларында, соның ішінде өнеркәсіп, энергетика, қаржы, қызмет көрсету, медицина, туризм және логистикада берік орнықты. Оны пайдалану процестерді оңтайландыруға, болжау дәлдігін жақсартуға, тәуекелдерді басқаруды жақсартуға және шығындарды азайтуға мүмкіндік береді. Дегенмен, айтарлықтай технологиялық прогреске қарамастан, ауыл шаруашылығы цифрландырудың ең баяу салаларының бірі болып қалуда. Бұл ретте халық санының өсуі, климаттың өзгеруі және табиғи ресурстардың деградациясы жағдайында ауыл шаруашылығының және жалпы агроөнеркәсіптік кешеннің азық-түлік қауіпсіздігін қамтамасыз етудегі рөлі және маңыздылығы арта түсуде.

Зерттеудің өзектілігі өсіп келе жатқан халық саны, табиғи ресурстардың сарқылуы, климаттық өзгерістер мен сыртқы ортаның құбылмалылығы жағдайында азық-түлік қауіпсіздігін қамтамасыз ету шешімдерін табу қажеттілігінде. Инновациялық технологиялар, соның ішінде жасанды интеллект (AI) және үлкен деректердің аналитикасы ауыл шаруашылығы өндірісін оңтайландыруда және азық-түлік шығындарын азайтуда маңызды рөл атқара алады. Азық-түлік қауіпсіздігінің 11-ші жаһандық индексіне (Economist Impact, 2024) сәйкес әлемдік азық-түлік жағдайы үшінші жыл қатарынан нашарлауда. Бұл үрдіс бірқатар аймақтарда аштық деңгейінің өсуімен, азық-түліктің қолжетімділігінің төмендеуімен және әлеуметтік-экономикалық тұрақтылықтың нашарлауымен қатар жүреді. Дүниежүзілік халықтар жөніндегі неміс қорының (2024) мәліметтері бойынша жер шарын-

дағы халық саны 8,16 миллиард адамға жетті, бұл азық-түлік жүйесіне қысымды күшейтуде. Алайда, азық-түлік қауіпсіздігін қамтамасыз ету үшін қажетті ресурстар бұл өсімге төтеп бере алмауда. 2050 жылға қарай дүние жүзіндегі адам саны 9,7 млрд-қа дейін үлғаяды (United Nations, 2024), өз кезегінде азық-түлікке деген қажеттілік 70%-ға артады (ФАО, 2024) деп болжамдалады. Сонымен бірге, парадоксалды жағдай – өндірілген азық-түліктің шамамен үштен бірі жыл сайын жоғалады немесе ысырап болады (Irani et al., 2018).

Бұл түрғыда ауыл шаруашылығын цифрландыру, оның ішінде жасанды интеллект (AI) және үлкен деректер технологияларын өндіріс барысына кіріктіру азық-түлік жүйелерінің тұрақтылығын арттырудың негізгі факторына айналуы мүмкін. Қазіргі заманғы технологиялық шешімдердің өзі ауылшаруашылық процестерін оңтайландыруға, дәл (нүктелік) егіншілік арқылы егін өнімділігін арттыруға, азық-түлік шығындарын азайтуға, сыртқы ортаның құбылмалылығымен, климаттың өзгеруімен және жабдықтаудың үзілуімен байланысты тәуекелдерді болжауды жақсартуға мүмкіндік береді.

Ауыл шаруашылығы өндірісіне жасанды интеллект құралдарын енгізу үлкен территорияға ие және климаттық шарттары түрлі болып келетін Қазақстан үшін өзекті болып отыр. Айта кететін жайт, Қазақстанның кең ауқымды жер ресурстарына ие болуы (272,5 млн. га) оны дүниежүзілік азық-түлік жүйесіндегі негізгі ойыншылардың біріне айналдырады. 2022 жылы ел азық-түлік қауіпсіздігінің жаһандық индексінде алдыңғы жылмен салыстырғанда 5 сатыға позициясын жақсартып, 113 елдің ішінде 32-ші орынға ие болды. Дегенмен, ауыл шаруашылығы саласының әлеуеті әлі де толық іске асырылмай отыр. Бұл түрғыда, жасанды интеллект әлеуетін егіншілікке, топырақ жағдайы мен дақылдардың жай-күйін бақылауға, суаруды автоматтандыруға, егін өнімділігін болжауға және өсімдіктер мен жануарлар ауруларының алдын алуға пайдалануға болады.

ҚР Стратегиялық жоспарлау және реформалар агенттігінің Ұлттық статистикалық бюросының (2024 ж.) мәліметтері бойынша ауыл шаруашылығының елдің жалпы ішкі өніміндегі үлесі 3,9 пайызды құрайды. Салыстыру үшін, дамыған елдерде (АҚШ, Германия, Франция) бұл көрсеткіш 1%-дан 3%-ға дейін ауытқиды, бұл автоматтандыру мен цифрлық шешімдердің арқасында сектордың жоғары өнімділігіне байланысты. Дамушы елдерде (Үндістан, Бразилия) ауыл шаруашылығының ЖІӨ-дегі үлесі жоғары (10–30%), бірақ технологиялық деңгей жиі төмен болып қалады (TheGlobalEconomy.com, 2024)

Осылайша, ауыл шаруашылығында жасанды интеллект құралдарын белсенді қолдану, оларды әзірлеу заманауи технологиялық үрдіс бола отырып, азық-түлік қауіпсіздігін арттыру, ауыл шаруашылығы жүйелерінің тұрақтылығын және жалпы ұлттық экономиканы жаңғыртудың стратегиялық маңызды бағытына айналуда.

Әдеби шолу

Жасанды интеллект қазіргі заманғы процестердің ажырамас элементіне айналуда және экономикалық модельдер мен өндіріс жүйелерін өзгертудегі оның маңыздылығы артуда. Соның ішінде, заманауи жасанды интеллект технологиялары ауылшаруашылық процестерін оңтайландыруға, дәл егіншілікті жүзеге асыруға, дақылдардың мониторингін жақсартуға және дақылдардың ауруларын диагностикалауға мүмкіндік береді (Pandey & Mishra, 2024:72-84). Бұл инновациялар ресурстардың тиімділігін арттырады және өндіріс тәуекелдерін азайтады (Azizi, 2024).

Бүгінгі таңда жасанды интеллект құралдарын ауыл шаруашылығы секторына белсенді енгізу деңгейі дамыған елдерде жоғарырық (Conesa-Muñoz et al. 2016) және жұмыс орындарын жоғалту ықтималдығы туралы алаңдаушылыққа қарамастан, бұл технология дамушы елдер үшін маңызды перспективалар ұсынады (Lor, 2018). Ғалымдардың зерттеулері AI әлеуеті егін өнімділігін арттыруды ғана емес, сонымен қатар тыңайтқыштар мен суаруды басқаруды жақсартуды, оңтайландырылған егін жинауды және егін жинаудан кейінгі процестерді тиімдірек басқаруды қамтитын көрсетті (Dharmaraj and Vijayanand, 2018; Eli-Chukwu, 2019; Lioutas et al., 2021; Shen et al., 2021).

Ауыл шаруашылығында цифрлық теңсіздіктің болуына қарамастан (Rotz et al., 2019; Lioutas et al., 2021), одан әрі дамыту, озық технологияларды енгізу үшін айтарлықтай мүмкіндіктер бар. AI қолдану, сонымен қатар, азық-түлік қауіпсіздігінің барлық төрт аспектісіне (азық-түлік қолжетімділігі (availability), экономикалық және физикалық қолжетімділік (accessibility), азық-түлікті тиімді пайдалану (utilization), тұрақтылық (stability)) әсер етеді (Chamara et al., 2020).

Сондай-ақ AI тамақ қалдықтарын азайту, азық-түлік сақтауды басқаруды жақсарту және жеткізу тізбегін оңтайландыру сияқты байланысты процестерде маңызды рөл атқарады (Pandey & Mishra, 2024; Azizi, 2024). AgriTech drone swarm intelligence технологиялары сияқты жаңа тәсілдер шалғай және қол жетімді емес аймақтарда ауыл шаруашылығы өнімділігін арттыруға мүмкіндік береді (Spanaki және т.б., 2021:1498-1516).

Экономикасы дамыған елдерде жасанды интеллект құралдарын енгізу процестерін, көп жағдайда, ғылыми зерттеулер мен инженерлік инновацияларға жауапты мемлекеттік органдар үйлестіреді. Бастапқыда бұл («Жасанды интеллект технологиялары» немесе «AI құралдары») технологиялар әскери және ғарыштық салаларда қолданылып, кейін ауыл шаруашылығында қолданыла бастады (Arakpogun et al., 2021:380). AI көмегімен ауылшаруашылық кәсіпорындары жерді өңдеу, дақылдарды өсіру үшін оңтайлы алаңдарды анықтай алады, су ресурстарын тиімді басқара алады, өсімдік және мал шаруашылығы шалдығуы мүмкін ауруларды ерте кезеңде анықтай алады және тыңайтқыштарды пайдалануды оңтайландырады, соның нәтижесінде едәуір шығындар мен қателіктердің деңгейін азайтады (Dharmaraj and Vijayanand, 2018).

Жасанды интеллектті енгізудің экономикалық пайдасы да әсерлі. Мысалы, AI Ұлыбританияның ЖІӨ-н болжам бойынша 10,3%-ға арттырады, бұл 232 млрд фунт стерлингке (шамамен 317 млрд АҚШ долл.) баламалы (PWC, 2017). Дүниежүзілік экономикалық форумның мәліметі бойынша, 2019 жылдан 2020 жылға дейін AI-ға инвестиция 40%-ға өсіп, 67,9 млрд АҚШ долл. жетті.

Бұндай тенденциялар жаһандық деңгейде жасанды интеллеттің артып келе жатқан маңызды экономикалық әлеуетін көрсетеді, дегенмен, оның жүзеге асырылу дәрежесі жекелеген елдердің цифрлық трансформацияға дайындығына тікелей байланысты болып келеді. Қазақстан үшін цифрлық ілгерілеу, цифрлық теңсіздікті жою және ауыл шаруашылығына жасанды интеллекті енгізудің кешенді стратегиясын әзірлеу маңызды. Бұл БҰҰ Тұрақты даму мақсаттарына (UNSDGs), атап айтқанда, «аштықтың нөлдік» деңгейіне жету, «жауапты тұтыну және өндіріс» мақсаттарына қол жеткізу және азық-түлік қауіпсіздігін жақсарту мақсатына жету үшін өзекті болып табылады.

Әдістеме

Зерттеу жұмысының әдістемесі ауыл шаруашылығы секторында жасанды интеллект пен үлкен деректер (Big Data) технологияларын енгізудің экономикалық тиімділігін кешенді бағалауға бағытталған. Әдістемелік негіз ретінде сапалық және сандық талдау тәсілдері үйлесімді түрде қолданылды.

Бірінші кезеңде теориялық-әдіснамалық база қалыптастырылды. Бұл мақсатта халықаралық және отандық ғылыми әдебиеттерге жүйелі шолу жүргізіліп, ауыл шаруашылығын цифрландыруға арналған стратегиялық және бағдарламалық құжаттар, халықаралық ұйымдардың (FAO, БҰҰ, ЮНЕСКО) есептері контент-талдау әдісі арқылы зерттелді.

Екінші кезеңде аграрлық секторда AI және Big Data технологияларын енгізудің халықаралық және қазақстандық тәжірибелеріне салыстырмалы талдау жүргізілді. Бұл ретте шетелдік және отандық агроинновациялық модельдер кейс-стади әдісі аясында қарастырылып, олардың тиімділік параметрлері мен қолдану ерекшеліктері сарапталды.

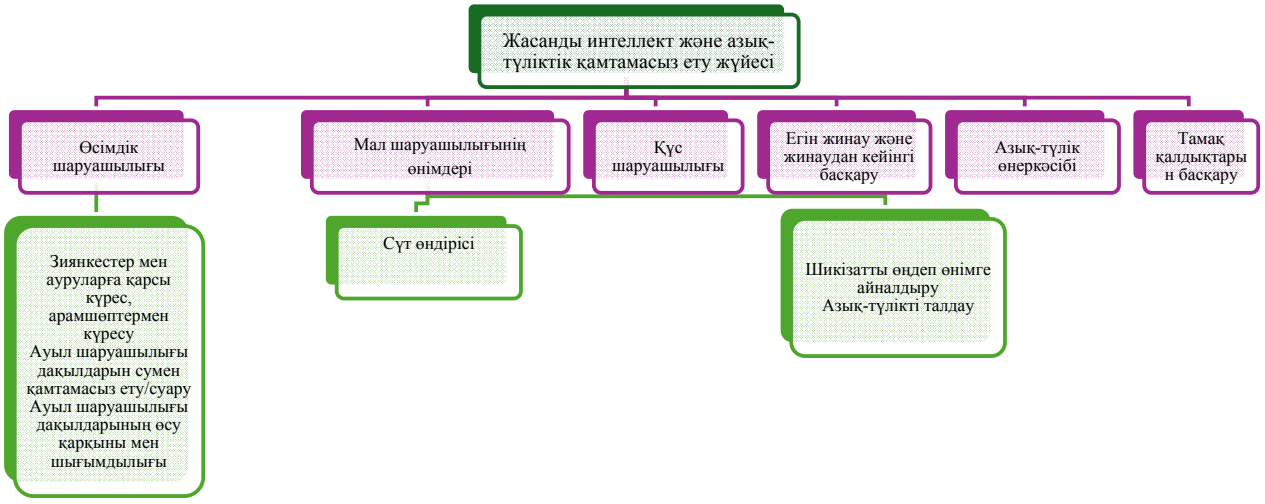
Үшінші кезеңде ауыл шаруашылығы мен инновациялық даму көрсеткіштері арасындағы өзара байланыс деңгейін сандық түрғыдан бағалау үшін Пирсон корреляция коэффициенті қолданылды. Бұл әдіс үздіксіз айнымалылар арасында сызықтық байланысты анықтауға бағытталған және зерттеудің макроэкономикалық деректер базасына сәйкес келеді. Корреляциялық талдау 2009–2023 жылдар аралығындағы ҚР Ұлттық статистика бюросының ресми деректерін пайдалану арқылы жүргізілді. Есептеулер Python бағдарламалық қамтамасыз ету тілінің көмегімен жүзеге асырылды. Әдістердің мұндай үйлесімі жасанды интеллекттің агросекторға ықпалын әр қырынан талдауға, зерттеу нәтижелерінің сенімділігі мен ғылыми жаңалығын қамтамасыз етуге мүмкіндік береді.

Нәтижелер мен талқылау

Мақалада ауыл шаруашылығы секторында жасанды интеллектті қолданудағы жаһандық үрдістерге баса назар аудара отырып, ауыл шаруашылығының негізгі секторларына талдау жасалады. Ауыл шаруашылығы өндірісінің тиімділігін арттыру, логистиканы оңтайландыру, ауылшаруашылық дақылдардың өнімділігін болжау және азық-түлік жүйелерінің тұрақты-

лығын арттыру үшін жасанды интеллект технологияларын қолданудың әлемдік тәжірибесін егжей-тегжейлі сараптау жүргізіледі. Талдау барысында процесті автоматтандыру, дақылдардың денсаулығын бақылау үшін машиналық оқытуды пайдалану және тәуекелдерді болжау және басқару үшін үлкен деректер аналитикасын пайдалануды қоса алғанда, бірнеше аспектілер қарастырылады.

Сонымен бірге, Қазақстандағы жағдайды салыстырмалы талдауға ерекше назар аударылады. Елдің аграрлық секторында жасанды интеллектті енгізудің қазіргі деңгейіне баға беріліп, одан әрі дамудың кедергілері мен мүмкіндіктері анықталады деп күтілуде. Ауыл шаруашылығын цифрландыруға бағытталған қолданыстағы ұлттық бастамаларды талдау және инновациялық технологияларды енгізуді ынталандыратын мемлекеттік бағдарламалар мен стратегияларды зерделеу маңызды. Алынған деректер негізінде халықаралық тәжірибе мен жергілікті ерекшеліктерді ескере отырып, Қазақстанның ауыл шаруашылығында жасанды интеллект құралдарын тиімді пайдалану тұжырымдамасы ұсынылатын болады. *MDPI Sustainability* (2021) және *MDPI Agronomy* (2023) секілді рецензияланатын журналдарда жарияланған мақалалардың материалдарына жүйелі шолу жүргізе отырып, әлемдегі ауыл шаруашылығы секторында жасанды интеллектті қолданудың бірнеше негізгі бағыттарын анықтауға болады:



1-сурет – Жасанды интеллект және азық-түліктік қамтамасыз ету жүйесі
Ескерту – (Pandey & Mishra, 2024), (Dhal & Kar, 2024) мәліметтері негізінде авторлар құрастырған

Жоғарыдағы ұсынылған шолу (1-сурет) негізінде ауыл шаруашылығы саласындағы түрлі бағыттар бойынша жасанды интеллект технологияларын қолданудың заманауи тәсілдерін қарастырайық.

Ауылшаруашылық дақылдарының өнімділігін арттыру және тұрақты өнім алуда негізгі кедергілерді бірі – бұл өсімдіктердің аурулары мен зиянкестері. Ауыл шаруашылығы саласы өсімдік ауруларына байланысты жыл сайын миллиардтаған доллар шығынға ұшырайды (Ahmad et al., 2023:27-32) және өсімдік шаруашылығында зиянкестермен, аурулармен, арамшөптермен күресу, сонымен қатар ауыл шаруашылығы дақылдарының өнімділігі мен өсу қарқынын арттыру негізгі өзекті мәселелер болып табылады. Мәселені шешудің тиімді жолдарының бірі – ауыл шаруашылығы дақылдарының ауруларын ерте анықтау. Осы бағытта жүргізілген зерттеулер жапырақ кескіндері негізінде ауруларды диагностикалау үшін жасанды интеллектті пайдалану нәтижесінде 75% дәлдікке қол жеткізуге болатынын көрсетті, бұл дәстүрлі диагностикалық әдістерден айтарлықтай жоғарырақ көрсеткіш.

Өсімдік шаруашылығындағы бұрыш ауруының таралу дәрежесін бағалау үшін Pseudomonas lini (PCA17) бактерияларының бұрыштың кеш күйікке қарсы биологиялық белсенділігін талдайтын PhytAi жүйесі қолданылды. Визуалды бағалау жасанды интеллект құралдарын қолдану арқылы салыстыру жүйенің жоғары дәлдігін

көрсетті. Күріш дақылдарындағы зиянкестерді ерте кезеңде анықтау үшін зиянкестердің суреттерін Imagga бұлттық платформасына жіберетін пилотсыз ұшатын аппараттарды (дрондарды) қолданатын әдіс әзірленді. Бұлтты жүйе зиянкестерді анықтайды және ақпарат фермерге әрі қарай әрекет ету үшін беріледі. Өз кезегінде, өсімдіктердің әртүрлі бөліктеріндегі күзгі күрттардың инвазиясын анықтау үшін терең үйіртілді нейрондық желіні қолдану арқылы жүгеріні өсіру барысындағы зиянкестермен күресте 87% дәлдікке қол жеткізілді.

Үқсас мәселелерді жасанды интеллект құралдары көмегімен шешу үшін, мысалы, Пәкістанда бидай ауруларын диагностикалауға арналған Android операциялық жүйесіндегі құрылғыларда жұмыс істейтін мобильді қосымша әзірленді. Бұл қолданба анық емес интерференция жүйесін пайдаланады және ауыл шаруашылығы 100 нақты дақылдарының ауруы жағдайында сыналып, 99% дәлдікті көрсетті (Toseef, & Khan, 2018:49-58).

Бидай мен күріш дақылдарының зиянкестерімен күресу үшін «Agpest» атты ауыл шаруашылығына арналған сараптамалық жүйе құрылған. Бұл жүйе жасанды нейрондық желілерді (ANN), генетикалық алгоритмдерді (GA) және компьютерлік көру технологияларын пайдаланады (Balleda және т.б., 2014:262-268). Өсімдіктердің ауруларын анықтауда үйірткілді нейрондық желілерді (CNN) пайдалану 25 түрлі өсімдіктердегі ауруларды диагностикалау үшін 99,53% әсерлі дәлдікті көрсетті (Ferentinos, 2018:311-318). Жүйе өсімдіктердің фотосуреттерін талдайды, аурудың тән белгілерін немесе зиянкестердің болуын анықтайды, бұл агрономдарға өсімдіктерді қорғау бойынша шараларды жылдам қабылдауға мүмкіндік береді. Бұл әдіс диагностиканың дәлдігін айтарлықтай жақсартады және ауыл шаруашылығының тұрақты дамуын қамтамасыз ете отырып, химиялық заттарды қолдануды барынша азайтады.

Сонымен қатар, үйірткілді нейрондық желілер (CNN) және рекуррентті нейрондық желілер (RNN) тіркесіміне негізделген жасанды интеллект бағдарламасын банан ағашының ауруларын ерте анықтау үшін әзірленді. Бұл модель ауруларды ерте кезеңдерінде тиімді анықтауға мүмкіндік беретін ағаштардағы суреттердің ретін талдайды. Бағдарлама фермерлерге егін шығынын барынша азайтуға және өсімдіктерді қорғау бойынша шұғыл шараларды жүзеге асыруға мүмкіндік береді (Nandhini, 2018).

Ауыл шаруашылығындағы арамшөптерді анықтау және олармен тиімді күресу үшін дақылдар мен арамшөптерді ажырата алатын «кездейсоқ орманды» (Random Forest) қолданатын әдіс әзірленді. Бұл тәсіл дрондардан немесе камералардан алынған суреттерді талдауға негізделген және объектілерді дәл тану үшін жіктеу алгоритмдерін қолданады. Бұл әдісті қолдану химиялық заттарды қолдануды барынша азайтуға, ауыл шаруашылығын экологиялық тұрғыда таза етуге, сонымен қатар арамшөптермен күресуге кететін шығындарды азайтуға көмектеседі (Gao et al., 2018:39–50).

Өз кезегінде, суару және ауыл шаруашылығы дақылдарын сумен жеткілікті көлемде қамтамасыз етуге келсек, қарбыз және басқа да ауылшаруашылық дақылдарының сумен қамтамасыз ету қажеттілігін тиімді анықтау үшін жасанды нейрондық желілерді (ANN) (Yamaç et al., 2021) пайдалануға болатынын айта кету керек. Ауқымды су балансы сияқты дәстүрлі әдістердің орнына нейрондық желілер оңтайлы суару тереңдігі мен кезеңін дәл болжау үшін күрделі және үлкен деректерді талдауға қабілетті.

Сонымен қатар, жартылай құрғақ аймақтарда қант қызылшасының булануын болжау үшін тірек векторлық машиналар (SVM), кездейсоқ орман (RF) және адаптивті күшейту (бустинг) сияқты әртүрлі жасанды интеллект алгоритмдері (Yamaç, 2021) пайдаланылды. Осы әдістердің ішінде SVM әдісі ең жақсы дәлдікті көрсетті және қант қызылшасының булануын бағалау үшін ең тиімді болып саналды. Бұл тәсіл ауыл шаруашылығында суға сұранысты болжау мен суаруды басқаруды айтарлықтай жақсарта алады.

Судың булануын азайту және суды пайдалануды оңтайландыру үшін су мен электр энергиясын пайдалануды жоспарлау үшін FPM әдісінде қолданылатын Левенбург-Маркварт әдісі және кері таралу әдісі сияқты ANN алгоритмдері әзірленді (Karasekreter, 2012). Ауылшаруашылық тиімділігін арттыру үшін AI зияткерлік жүйелерде суаруды және өнімділікті арттыру үшін гербицидтерді қолдану процестерін оңтайландыру үшін қолданылады. Бұған бүрку, суару және арамшөптерді жоюдың автоматтандырылған әдістері жатады (Talaviya, 2020).

Кез келген өңірде өнім көлемін картографиялау үшін (Zhang et al., 2022) тарихи егістік деректеріне, сондай-ақ қашықтықтан зондтау мәліметтеріне негізделген автоматтандырылған әдіс әзірленді. Бұл әдіс егістік алқаптарының

кеңістіктік-уақыттық сипаттамаларын ескере отырып, жыл мезгіліне қарамастан, дақыл түрлерін дәл әрі тиімді түрде жіктеуге мүмкіндік береді. Жүйе нақты өңірдің тарихи деректеріне сүйенетіндіктен, картографиялау нәтижелерінің нақтылығы мен өзектілігі жоғары деңгейде қамтамасыз етіледі.

Ал күріштің өсу қарқынын болжау барысында жасанды нейрондық желілердің дәлдігі регрессиондық алгоритмдермен салыстырғанда анағұрлым жоғары екені дәлелденді. Бұл ретте ген экспрессиясын бағдарламалау да қарастырылған. Өнім жинау мерзімін оңтайландыру және ресурстарды тиімді пайдалану мақсатында жасанды нейрондық желілер мен генетикалық алгоритмдер өнімнің өсу кезеңін дәл анықтай алады (Liu, 2021).

Сондай-ақ соя дақылының өнімділігін болжау үшін терең нейрондық желілерді қолданатын байесовтық мультимодельдеу әдісі тиімді нәтиже көрсетті (Abbaszadeh, 2022).

Егіс алқаптарын бақылау мақсатында дрондарды қолдану нәтижесінде осыған дейін қолмен орындалатын операцияларға кететін уақыт едәуір қысқарғаны байқалды (Balan, 2016:74).

Жоғарыда қарастырылған бағыттар аясында Қазақстандағы ауылшаруашылығы саласын цифрландыру және жасанды интеллект элементтерін енгізу белсенді түрде жүзеге асырылып келеді. Қазіргі кезеңде бірқатар цифрлық жүйелер іс жүзінде жұмыс істеуде. Атап айтқанда, мемлекеттік субсидиялау жүйесі, ауыл шаруашылығы жануарларын сәйкестендіру жүйесі, АӨК-ті басқаруға арналған «e-Agriculture» автоматтандырылған платформасы, сондай-ақ «Ауыл аманаты» бағдарламасы шеңберіндегі микрокредиттеу бойынша ақпараттық жүйе. Сонымен қатар, өсімдік шаруашылығындағы өнімнің қадағалану жүйесі әзірлеу сатысында тұр (2025 жылдың ақпан айы жағдайы бойынша) (Bluescreen.kz, 2025).

Қазақстан Республикасы Ауыл шаруашылығы министрлігінің мәліметінше, 2024 жылдан бастап өсімдік шаруашылығы өнімдерінің айналымын толық қамтитын – тұқым себуден бастап экспортқа дейінгі – қадағалау жүйесі кезең-кезеңімен енгізілуде. Бұл бастама ауыл шаруашылығы өндірісінің ашықтығын арттыруға және өнімнің сапасын бақылауды күшейтуге бағытталған. Сонымен қатар, министрліктің мәліметіне сәйкес, жасанды интеллект негізіндегі бірқатар шешімдер ендірілуде: субсидиялауға өтінімдерді қабылдайтын чат-боттар, топырақ құрамын бағалайтын интеллектуалды талдау жүйелері, зиянкестермен күрес жүргізетін дрондар, сондай-ақ өнімділік пен климаттық тәуекелдерді болжау және суару үдерісін оңтайландыру құралдары (Bluescreen.kz, 2025).

Astana Hub ұсынған мәліметтерге сүйенсек (Astana Hub, 2024), бүгінде Қазақстанда 116 миллион гектардан астам ауыл шаруашылығы жерлері спутниктік мониторинг жүйесіне қосылған. Бұл тәсіл егістік алқаптарының жағдайын тұрақты бақылауға, олардың мақсатты және тиімді пайдаланылуын бағалауға, сондай-ақ мемлекеттік органдардың бірыңғай базасымен деректер алмасуға жол ашады. Осындай технологиялар арқылы жасанды интеллектке негізделген басқару шешімдерін қабылдаудың жаңа мүмкіндіктері пайда болуда.

Сонымен қатар, 2022 жылдан бері мемлекетке тиімсіз пайдаланылып келген 12 миллион гектар жер қайтарылған. Бұл шаралар жер ресурстарын тиімді басқарудың маңызды бөлігі ретінде қарастырылады.

Сондай-ақ, 2024 жылдан бастап өсімдік шаруашылығындағы өнім қозғалысын тұқым себуден бастап экспортқа дейін бақылауға мүмкіндік беретін қадағалау жүйесі іске қосыла бастады. Бұл жүйе ашықтықты қамтамасыз етіп қана қоймай, жасанды интеллектті өндірістің барлық кезеңіне ендіруге алғышарт жасайды.

Жоғарыда аталған бастамалармен қатар, Қазақстан Біріккен Ұлттар Ұйымының Азық-түлік және ауыл шаруашылығы ұйымына (ФАО) жер деградациясымен күрес бағдарламаларына жасанды интеллектті енгізуге бағытталған жобаны қаржыландыру үшін ресми түрде жүгінген. Аталған бастама Қазақстан аумағында кең таралған үйірлі шегірткелердің (азиялық, мароккалық және италиялық түрлері) ауыл шаруашылығы дақылдарына келтіретін залалын азайту қажеттілігімен негізделеді. Жоба шеңберінде зиянкестердің таралу ошақтарын ерте анықтауға және мониторинг жүргізуге арналған геоақпараттық жүйені жасанды интеллект элементтерімен әзірлеу көзделіп отыр (AgroSektor.kz, 2025).

Ауыл шаруашылығы өндірісінің цифрлық трансформациясы тек егін шаруашылығымен шектелмейді. Соңғы жылдары жасанды интеллект пен смарт-технологиялар мал шаруашылығы саласына да белсенді түрде енгізілуде. Алайда табысы төмен және орта деңгейдегі елдерде бұл технологиялардың салаға нақты әсері жөнінде толыққанды деректер әлі де жеткіліксіз. Мұндай елдер қатарына кіретін Кения мен

Үндістанда цифрлық құралдар сүтті ірі қара мен құс шаруашылығында белсенді қолданылады. Атап айтқанда, бұл құралдар табынды бақылау, жайылымдарды басқару және қолдан ұрықтандыру секілді процестерді оңтайландыруда қолданылады.

Мысалы, Farmtree қосымшасы фермер енгізген деректер негізінде лактация кезіндегі сүт өнімділігін, өнімділік шыңын және тәуліктік сауынды есептейді. Бұл шешімдер фермерлерге сүт өндірісін оңтайландыруға көмектеседі. Сонымен қатар, терең оқытуға негізделген жүйелер арқылы сиырларды автоматты түрде сәйкестендіру және олардың күйін бағалау құралдары әзірленген. Мұндай жүйелер жануардың семіздігін нақты бағалауға және адам факторынан туындайтын қателіктерді азайтуға мүмкіндік береді (Daum, 2022).

Сондай-ақ, өнімділік көрсеткіштерін болжау саласында да жасанды нейрондық желілер өз артықшылығын көрсетті. Мысалы, сиырлардың сүт бездерінің ультрадыбыстық бейнелері негізінде олардың өнімділік кезеңі мен күтілетін тәуліктік сауынды болжауға арналған жүйелер құрылды. Бұл әдістер дәстүрлі Вуд моделіне қарағанда анағұрлым жоғары дәлдікпен нәтиже береді және үлкен деректер көлемін қажет етпейді (Sun, 2019).

Ал, Moocare секілді Интернет заттар жүйесіне (IoT) негізделген платформалар фермерлерге әр сиырдың өнімділігін жекелей бақылауға, азықтандыру режимін нақтылауға және уақытылы түзетулер енгізуге мүмкіндік береді. Бұл жүйелер нақты уақыт режимінде ақпарат ұсынып, фермерлік шешімдерді жылдам әрі дәл қабылдауға жәрдемдеседі (da Rosa Righi, 2019).

Жануарлар денсаулығын бақылау – цифрлық шешімдердің тағы бір маңызды бағыты. Мысалы, машиналық оқыту мен «тұманды есептеулер» (fog computing) технологиясына негізделген хромотаны (ақсауды) ерте анықтау жүйесі әзірленді. Бұл жүйе ауру белгілерін адамның көзіне көрінбей тұрып бірнеше күн бұрын анықтай алады. Мұндай тәсіл емдеудің тиімділігін арттырып, шығындарды азайтады (Denholm, 2020).

Жалпы алғанда, жасанды интеллект, машиналық оқыту және IoT шешімдері мал шаруашылығы саласындағы тиімділік пен тұрақтылықты арттыруға бағытталған қуатты құралға айналып отыр. Әсіресе, дамушы экономикаларда бұл технологиялар фермерлік шаруашылықты жаңа сапалық деңгейге көтеруге мүмкіндік береді.

Елдегі мал шаруашылығы саласында жасанды интеллект технологияларын енгізу бойынша бірқатар нақты жобалар жүзеге асырылуда. Солардың ішінде ерекше атап өтуге болатын бастамалардың бірі – ірі қара малды тануға арналған интеллектуалды жүйенің әзірленуі. Бұл жүйе YOLOv5, ArcFace және Paddle OCR алгоритмдеріне негізделіп жасалған және малдың бет-пішіні мен құлақ таңбасын автоматты түрде тану мүмкіндігін береді. Мұндай тәсіл субсидиялау жүйесіндегі алаяқтық әрекеттердің алдын алуға және мал басын есепке алу жүйесінің ашықтығын қамтамасыз етуге мүмкіндік береді (Sputnik Казахстан, 2024).

Сонымен қатар, Ақмола облысындағы «Еңбек» ЖШС негізінде жасанды интеллектпен басқарылатын заманауи сүт-тауарлы ферма құрылған. Бұл фермада сиырларды сауу және азықтандыру процестері толығымен автоматтандырылған. Малдар арнайы орнатылған доильді станцияларға өз еркімен келеді, ал жүйе әрбір жануардың физиологиялық жағдайы мен соңғы сауу уақытын талдау арқылы қолжетімділікті реттейді. Мұндай шешімдер адам еңбегінің араласуын барынша азайтып, сүт өндірісінің тиімділігін арттыруға септігін тигізеді (Нығметов, 2025).

Ауыл шаруашылығы саласында жасанды интеллектті енгізу үрдістерін жүйелі түрде талдағаннан кейін, саланың дамуына ықпал ететін негізгі факторларды сандық түрғыдан бағалау қажеттілігі туындайды. Осы мақсатта инновациялық белсенділік, ғылыми-зерттеу және тәжірибелік-конструкторлық жұмыстарға (ҒЗТКЖ) инвестициялар көлемі, сондай-ақ аграрлық өндірістің тұрақтылығымен байланысты бірқатар көрсеткіштер таңдалып алынды.

Алдағы корреляциялық талдау осы айнымалылар арасындағы өзара байланыс деңгейін анықтауға бағытталған. Бұл агросектордың технологиялық трансформациясын негіздеуге және стратегиялық шешімдер қабылдауға ғылыми база қалыптастыруға мүмкіндік береді. Қолданылатын негізгі көрсеткіштер тізімі 1-кестеде келтірілген.

1-кесте – Ауыл шаруашылығы саласындағы жасанды интеллект пен инновациялық даму көрсеткіштерінің сипаттамасы

№	Көрсеткіштер атауы	Сипаттамасы
1	Ауыл шаруашылығының ЖІӨ-сі (Agri GDP), млн теңге	Экономиканың аграрлық секторындағы негізгі интегралды көрсеткіш. Оның инновациялармен және инвестициялармен өзара байланысын талдау жасанды интеллект пен технологиялық шешімдердің өнімділік пен тиімділікке әсерін бағалауға мүмкіндік береді.
2	Ауыл шаруашылығына салынған инвестициялар (Agri Inv), млн теңге	Мемлекеттік және жекеменшік инвестициялардың деңгейін сипаттайды. Инвестициялар ағынының артуы ауыл шаруашылығында, соның ішінде ИИ шешімдерін енгізу бағытында белсенділіктің жоғарылауына ықпал етуі мүмкін.
3	Ауыл шаруашылығы саласындағы ҒЗТКЖ шығындары, млн теңге	Білім мен технологиялық әзірлемелерге салынған инвестициялар деңгейін көрсетеді. Бұл көрсеткіш цифрлық трансформация үшін маңызды.
4	ҒЗТКЖ жүргізетін компаниялар саны (R&D Firms)	Елдің ғылыми-техникалық әлеуетін сипаттайды. Аграрлық салада жасанды интеллектке қатысты шешімдердің әзірленуі мен қолданылу деңгейін жанама түрде көрсетеді.
5	Инновациялық белсенділік деңгейі (Innov Act)	Елдегі жалпы технологиялық қабылдағыштық деңгейін бағалауға мүмкіндік береді. Инновациялық белсенділіктің жоғары деңгейі ауыл шаруашылығында ИИ шешімдерін енгізуге қолайлы орта қалыптастырады.
6	Жоғары технологиялық өнім экспорты (Hi-tech Exp)	Елдің жоғары қосылған құны бар өнім өндіру және экспорттау қабілетін сипаттайды. Мұндай өнімдердің болуы ИИ шешімдерін әзірлеу әлеуетінің бар екенін көрсете алады.
7	Өңдеу өнеркәсібіне салынған инвестициялар (Manuf Inv), млн теңге	Технологиялық жаңғырту деңгейін сипаттайды. Бұл салалар ауыл шаруашылығы үшін қажетті ИИ-технологияларды жеткізуші болуы мүмкін.
8	Инновациялық сектордың ЖІӨ-дегі үлесі (Innov GDP), %	Жалпы экономиканың инновациялық дамуын сипаттайды. Бұл көрсеткіш ИИ-дың ұлттық даму деңгейінде қандай рөл атқара алатынын түсінуге мүмкіндік береді.
9	Өңдеу өнеркәсібіндегі инновацияларға жұмсалатын шығындар (Manuf Innov Cost), млн теңге	Өңдеуші сектордағы технологиялық көшу мен ИИ шешімдерін әзірлеуге бөлінген инвестициялар көлемін көрсетеді. Бұл ауыл шаруашылығы үшін маңызды технологиялардың қолжетімділігін көрсетеді.
Ескерту – көрсеткіштерді таңдау ғылыми әдебиеттегі деректерге, салалық маңыздылығына және өзара ықпалдастықты талдау қажеттілігіне негізделді		

Осы орайда, Қазақстанда аграрлық секторды цифрландыруға бағытталған белсенді қадамдарға қарамастан, жасанды интеллект технологияларын дамыту әлі де бастапқы кезеңде екенін мойындау қажет. Зерттеудің негізгі қиындықтарының бірі – сала бойынша егжей-тегжейлі статистикалық деректердің жеткіліксіздігі, әсіресе ауыл шаруашылығы мен азық-түлік қауіпсіздігі салаларында жасанды интеллектті қолдану бойынша нақты мәліметтердің болмауы.

Осыған байланысты бұл зерттеуде инновациялық белсенділік, ғылыми әзірлемелер көлемі мен технологиялық прогресс деңгейін жанама сипаттайтын көрсеткіштер пайдаланылды. Бұл индикаторлар ауыл шаруашылығы саласында ЖИ енгізуге ықпал ететін орта туралы базалық түсінік алуға мүмкіндік береді.

Болашақта зерттеулер арнайы мәліметтер базасын қалыптастыру мен жасанды интеллекттің аграрлық өнімділік пен азық-түлік қауіпсіздігіне әсерін тереңірек талдау бағытына бағытталуы мүмкін. Мұндай тәсіл сала ерекшеліктерін ескере отырып, ЖИ-ды тиімді енгізудің стратегияларын әзірлеуге мүмкіндік береді.

2-кестеде 2009–2023 жылдар аралығындағы эмпирикалық зерттеуге енгізілген негізгі айнымалылар бойынша сипаттамалық статистика ұсынылған. Бұл бөлімде арифметикалық орта мән (Mean), стандарттық ауытқу (Std. Dev.), ең төменгі (Min) және ең жоғарғы (Max) мәндер көрсетілген. Берілген статистика көрсеткіштердің таралуы мен өзгеріс ауқымын бағалауға мүмкіндік береді және келесі корреляциялық талдаудың бастапқы негізі ретінде қызмет етеді.

2-кесте – Сипаттамалық статистика

	Көрсеткіштер атауы	Орташа	Стандартты ауытқу	Минимум	Максимум
1	Ауыл шаруашылығының ЖІӨ-сі (Agri GDP), млн теңге	1086214,81	728789,96	280644,63	2776961,14
2	Ауыл шаруашылығына салынған инвестициялар (Agri Inv), млн теңге	362394,47	289151,76	77544,00	904264,00
3	Ауыл шаруашылығы саласындағы ҒЗТКЖ шығындары, млн теңге	8693,10	4905,35	3310,94	20109,90
4	ҒЗТКЖ жүргізетін компаниялар саны (R&D Firms)	395	27,3	341	438
5	Инновациялық белсенділік деңгейі (Innov Act)	8,63	2,64	4,00	11,70
6	Жоғары технологиялық өнім экспорты (Hi-tech Exp)	2707955794,40	946824367,49	1772255489	5145671171
7	Өңдеу өнеркәсібіне салынған инвестициялар (Manuf Inv), млн теңге	11,56	1,06	10,28	13,61
8	Инновациялық сектордың ЖІӨ-дегі үлесі (Innov GDP), %	1,40	0,54	0,49	2,43
9	Өңдеу өнеркәсібіндегі инновацияларға жұмсалатын шығындар (Manuf Innov Cost), млн теңге	462823,58	408085,14	27819,74	1358039,30
Ескерту – Статистикалық деректер ҚР Стратегиялық жоспарлау және реформалар агенттігіне қарасты Ұлттық статистика бюросының «Салалық статистика» және «Экономика» бөлімдеріндегі ашық деректер негізінде авторлар тарапынан жиналып, өңделді					

Үсынылған айнымалылар бойынша сипаттамалық статистика Қазақстандағы ауыл шаруашылығына жасанды интеллектті (ЖИ) енгізу әлеуетін айқындайтын негізгі экономикалық және инновациялық көрсеткіштердің қазіргі жай-күйін бағалауға мүмкіндік береді. Алынған мәндер экономикалық даму деңгейі мен инновациялық белсенділіктің жоғары әркелкілігін көрсетеді, бұл өз кезегінде өсу нүктелерінің де, жүйелі шектеулердің де бар екенін айғақтайды.

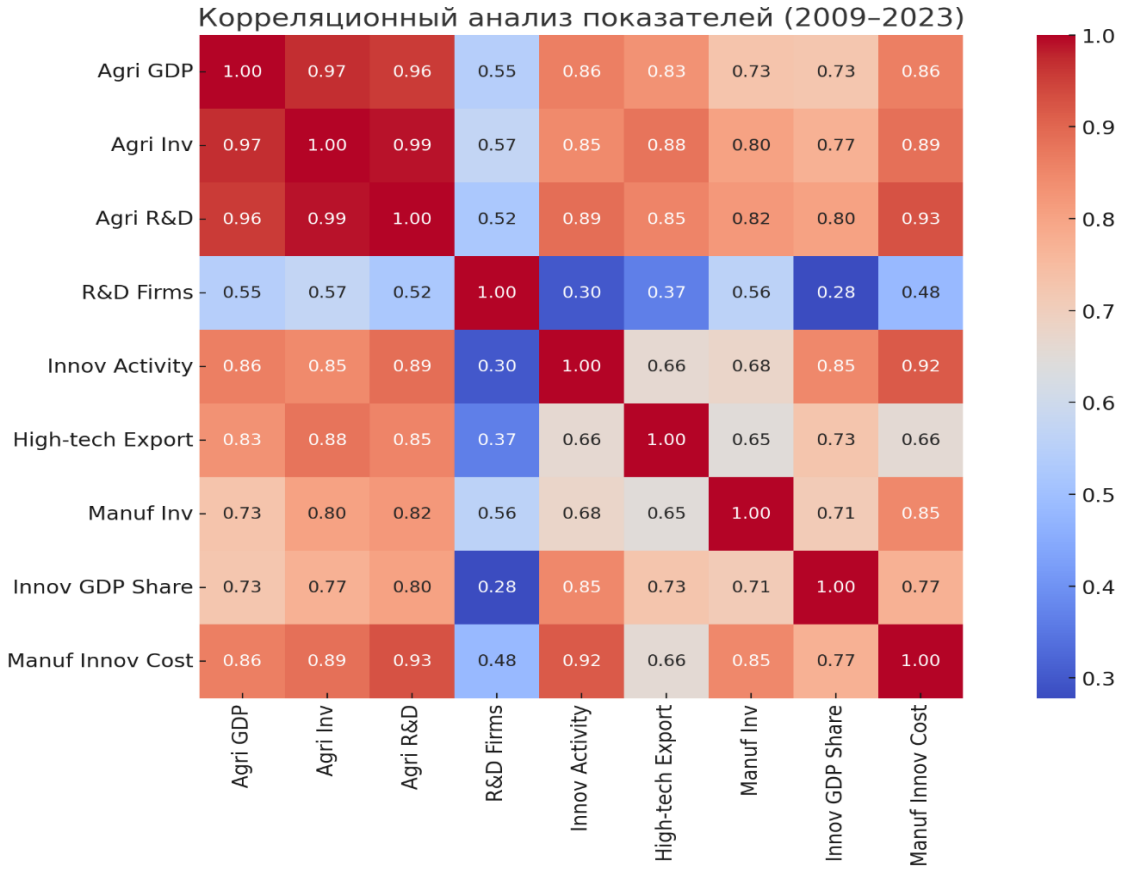
2-кестеге талдау жүргізсек, ауыл шаруашылығының жалпы өнімі қарастырылып отырған кезең аралығында (2009-2023) орта есеппен 1086,2 млрд теңгені құрады, алайда көрсеткіштің дисперсиясы айтарлықтай жоғары (280,6 млрд теңгеден 2776,9 млрд теңгеге дейін), бұл саланың тұрақсыздығын және сыртқы күйзелістерге сезімталдығын білдіреді. Осындай үрдіс ауыл шаруашылығына тартылған инвестициялар көлемінде де байқалады – 77,5-тен 904,3 млрд теңгеге дейін. Бұл деректер агросекторды жаңғыртуға, соның ішінде цифрлық трансформацияға капитал салымдарының жеткіліксіз екенін көрсетеді.

Ауыл шаруашылығы ғылымындағы ҒЗТКЖ шығындары да төмен деңгейде қалып отыр – орта есеппен 8693 млн теңге. Бұл заманауи технологияларды, оның ішінде ЖИ шешімдерін әзірлеу мен бейімдеуді шектейді. ҒЗТКЖ-мен айналысатын компаниялар саны (орта есеппен 395) іс жүзінде өзгеріссіз қалуда, бұл аграрлық саладағы инновациялық инфрақұрылымның жеткілікті дамымағанын дәлелдейді.

Инновациялық белсенділік деңгейі (8,63%) мен инновациялық сектордың ЖІӨ-дегі үлесі (1,4%) экономиканың жалпы цифрлық жетілу деңгейінің төмендігін көрсетеді. Дегенмен, жоғары технологиялық өнім экспорты көлемінің күрт ауытқуы (177,2 млрд теңгеден 5145,7 млрд теңгеге дейін) бір реттік ірі жеткізілімдермен немесе секірмелі экспорттық операциялармен түсіндірілуі мүмкін, бұл тереңірек талдауды қажет етеді.

Жалпы алғанда, оң үрдістердің жекелеген белгілеріне қарамастан, деректер жасанды интеллекті ауыл шаруашылығына кең ауқымда енгізу үшін жүйелі мемлекеттік қолдаудың және жекеменшік инвестицияларды тартудың қажеттігін көрсетеді.

Ал төмендегі 2-суретте жүргізілген корреляциялық талдаудың нәтижелері келтірілген.



2-сурет – Инновациялық белсенділік пен экономикалық даму көрсеткіштерінің корреляциялық матрицасы
Ескерту – Статистика комитетінің деректері негізінде Python бағдарламалау тілі арқылы авторлар құрастырған

2-суретте көрсетілген корреляциялық талдау Қазақстандағы ауыл шаруашылығының ағымдағы ахуалы мен жасанды интеллект (ЖИ) технологияларын енгізу әлеуетін сипаттайтын негізгі экономикалық және инновациялық көрсеткіштер арасындағы өзара байланыстарды кешенді түрде ашып көрсетеді.

Ауыл шаруашылығының жалпы ішкі өнімі (Agri GDP), салалық инвестициялар (Agri Inv) және аграрлық ҒЗТКЖ-ға жұмсалатын шығындар (Agri R&D) арасындағы жоғары оң корреляция ($r > 0,96$) агросектордың дамуы көбіне инвестициялық қарқындылық пен ғылыми қолдау деңгейіне тәуелді екенін көрсетеді. Бұл – кездейсоқ байланыс емес, жүйелі экономикалық заңдылық. Демек, жасанды интеллекті табысты енгізу үшін қаржыландыру мен ғылыми инфрақұрылымды теңгерімді дамыту – алғышарт ретінде қарастырылуы тиіс.

Сонымен қатар, ҒЗТКЖ жүргізетін компаниялар санының басқа айнымалылармен корреляциясының төмен болуы ($r=0,28–0,55$) агросектордағы инновациялық инфрақұрылымның оқшау сипатта екенін және оның өндірістік жүйелермен әлсіз ықпалдасқанын аңғартады. Бұл жағдай білім мен технология трансферінің тиімділігіне тосқауыл қойып, ЖИ шешімдерінің кеңінен таралуын тежейді. Бұл тек техникалық емес, институционалдық тосқауыл болып табылады және ол агроинновациялық экожүйені қалыптастыру жолындағы негізгі кедергілердің бірі ретінде танылуы қажет.

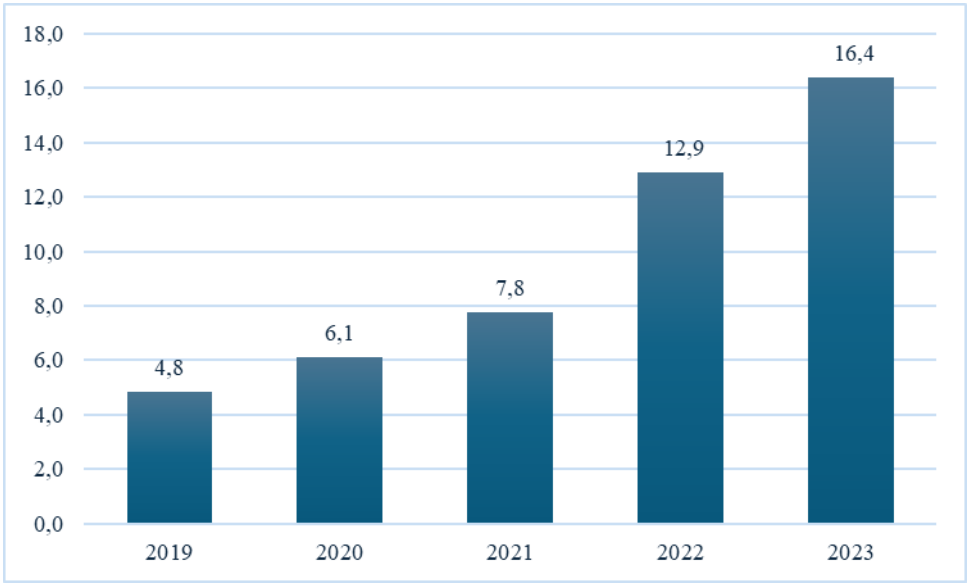
Инновациялық белсенділік деңгейі (Innov Act) мен жоғары технологиялық өнім экспортының (Hi-tech Exp) ауыл шаруашылығына салынатын инвестициялармен тығыз байланысы ($r = 0,85$ және $r = 0,66$) аграрлық секторда қалыптасып келе жатқан инновациялық ортаның ішкі және сыртқы нарықтарға ықпал етіп жатқанын көрсетеді. Бұл – агротехнологиялық жетілудің бастапқы белгілері. Алайда, мұндай жүйе жасанды интеллектті енгізу үшін жеткіліксіз: инновациялық орта, инвестициялық климат және технологиялық күрделілікке деген қабылдағыштық – қатар өрбуі тиіс факторлар.

Сондай-ақ, инновациялық сектордың ЖІӨ-дегі үлесі (Innov GDP Share) мен өңдеу өнеркәсібіндегі инновациялық шығындар (Manuf Innov Cost) арасындағы жоғары байланыс (r = 0,77) аграрлық емес салалардың да агросекторға жанама әсерін көрсетеді. Бұл – ауыл шаруашылығы цифрлық трансформацияның тек алушысы ғана емес, жүйелік ойыншы екенін айғақтайды. Осылайша, жасанды интеллектті енгізу – тек аграрлық саясат шеңберіндегі мәселе емес, ол ұлттық инновациялық жүйе мен индустриялық даму стратегиясының қиылысында шешімін табуы тиіс.

Жалпы алғанда, жүргізілген талдау ЖИ-ды ауыл шаруашылығына тиімді және тұрақты енгізу тек кешенді тәсіл аясында ғана мүмкін екенін айғақтайды. Мұндай тәсіл инвестициялар, ғылыми-зерттеу қызметі, инновациялық белсенділік және институционалдық қолдау арасында синергияны талап етеді. Ғылым мен өндіріс арасындағы алшақтықты жою, технологиялық инфрақұрылымды нығайту және инновациялық сұранысты ынталандыру – агроөнеркәсіптік кешенді цифрландырудың негізгі стратегиялық бағытына айналуы тиіс.

Жоғарыда атап өткеніміздей, қазіргі таңда ресми дереккөздерде Қазақстанның ауыл шаруашылығы саласында жасанды интеллект технологияларын енгізу деңгейін нақты бейнелейтін статистикалық көрсеткіштер жоқ. Тіпті, ұлттық статистикалық жүйеде жасанды интеллекті қолдану салалық немесе салааралық бөліністе мүлде есепке алынбайды. Дегенмен, соңғы жылдары Қазақстан Республикасы Ұлттық статистика бюросы цифрлануға қатысты бірқатар көрсеткіштерді тіркей бастады, оның ішінде өнеркәсіп саласында цифрлық технологияларды қолдану деңгейі де бар. Бұл деректер ауыл шаруашылығын тікелей қамтымағанымен, экономиканың жалпы цифрлық жетілуін бағалауға бағдар бола алады және агроөнеркәсіптік кешенге жасанды интеллектті енгізуге болашақта қолайлы инфрақұрылымдық және институционалдық алғышарттардың қалыптасу деңгейін жанама түрде көрсетеді**.**

Осындай жанама индикаторлардың бірі – цифрлық технологияларды қолданатын ірі және орта кәсіпорындардың үлесі**.** Қазақстан Республикасы Ұлттық статистика бюросының деректеріне сәйкес, бұл көрсеткіштің өсім қарқыны тұрақты оң динамиканы көрсетіп отыр: 2019 жылы 6,1%-дан 2022 жылы 16,4%-ға дейін өсті (3-сурет).



3-сурет – Өңдеу өнеркәсібінде цифрлық технологияларды пайдаланатын ірі және орта кәсіпорындардың үлесі, %
Ескерту – (Қазақстан Республикасы Стратегиялық жоспарлау және реформалар агенттігі, б.ж.) деректері негізінде авторлар құрастырған

Бұл, бір жағынан, өнеркәсіп секторының цифрлық жетілу деңгейінің артып келе жатқанын білдірсе, екінші жағынан, цифрлық шешімдерді, соның ішінде жасанды интеллект технологияларын масштабтауға қабілетті инфрақұрылымдық және технологиялық базаның қалыптасып жатқанын көрсетеді. Бұл үрдіс ауыл шаруашылығы сияқты басқа секторларға жасанды интеллекті енгізуге жанама түрде әсер етуі мүмкін.

Сондай-ақ елдің цифрлық жетілу деңгейін бағалауға бағытталған жалпы интегралды көзқарас ретінде халықаралық рейтингтерге жүгінуге болады. Мәселен, IMD World Digital Competitiveness Ranking 2024 есебіне сәйкес (IMD World Competitiveness Center, 2024), Қазақстан 67 елдің ішінде 34-орынды иеленіп, цифрлық даму саласында тұрақты позицияға ие екенін көрсетеді. Нақтырақ айтқанда, ел білім деңгейі бойынша 33-орында, технологиялық даму деңгейі бойынша – 46-орында, ал болашаққа дайындық деңгейі бойынша – 27-орында орналасқан.

Аталған IMD World Digital Competitiveness Ranking 2024 есебін егжей-тегжейлі талдау Қазақстанның бірқатар мықты жақтары бар екенін көрсетеді. Атап айтқанда, білім беру саласы бойынша (кадрлар даярлау компоненті – 2-орын) және бизнестің икемділігі (5-орын) бағыттары елдің түрлі салаларында, соның ішінде агроөнеркәсіптік кешенде де, жасанды интеллект технологияларын енгізуге негіз бола алады. Дегенмен, технологиялық инфрақұрылым мен IT-интеграция деңгейі (52–56-орындар аралығы) әлсіз түстар ретінде көрініп отыр, бұл ауыл шаруашылығына жоғары технологиялық шешімдерді енгізуді тежейтін фактор болуы мүмкін.

Аталған шектеулерді ескере отырып, саланы цифрлық трансформациялау үшін кешенді тәсіл қажет екені айқын. Бұл – инфрақұрылымды дамыту, жасанды интеллектке инвестиция тарту және салааралық үйлестіруді күшейту бағытында жүйелі іс-қимылдарды талап етеді.

Қорытынды

Зерттеу нәтижелері ауыл шаруашылығында жасанды интеллект технологияларын енгізу Қазақстан үшін стратегиялық маңызы бар бағыт екенін дәлелдеді. Халық санының өсуі, климаттық өзгерістер және азық-түлік жүйелеріне түсетін қысым жағдайында жасанды интеллект – агроөнеркәсіптік кешеннің тиімділігін арттырудың, тәуекелдерді басқарудың және азық-түлік қауіпсіздігін қамтамасыз етудің қуатты құралы ретінде танылып отыр.

Мақалада қарастырылған шетелдік кейстердің нәтижесі көрсеткендей, жасанды интеллект технологиялары дақылдарды бақылау, өнімділікті болжау, арамшөптер мен зиянкестерді анықтау, суаруды оңтайландыру және малдың денсаулығын бақылау секілді түрлі процестерде тиімді қолданылуда. Сонымен бірге, отандық талдау көрсеткендей, Қазақстанда жасанды интеллект енгізу әлеуеті болғанымен, оны кеңінен қолдануға бірқатар жүйелік шектеулер кедергі келтіруде. Атап айтқанда, ҒЗТКЖ инвестициясының төмендігі, инновациялық инфрақұрылымның жеткіліксіздігі және институционалдық қолдаудың әлсіздігі байқалады.

Корреляциялық талдау нәтижелері ауыл шаруашылығының дамуы мен жасанды интеллект енгізу арасындағы тікелей өзара байланысты көрсетті. ЖІӨ, инвестициялар және ғылыми-зерттеу белсенділігі арасындағы жоғары корреляция жасанды интеллект енгізудің негізі ретінде қаржылық және ғылыми факторлардың маңыздылығын растайды. Алайда, зерттеу барысында цифрлық инфрақұрылымның жетілмегендігі, ЖИ қолдануға арналған нақты статистиканың болмауы сияқты елеулі қиындықтар анықталды.

Осыған байланысты, Қазақстанда ауыл шаруашылығына жасанды интеллекті тиімді енгізу үшін келесі басым бағыттары қарастырылады:

Мемлекеттік қолдауды күшейту: жасанды интеллект шешімдерін әзірлеуге және енгізуге бағытталған мақсатты мемлекеттік бағдарламалар мен қаржыландыру тетіктерін енгізу;

Ғылыми-инновациялық инфрақұрылымды дамыту: ғзткж-ға салынатын инвестицияны үлғайту, аграрлық салада стартаптар мен ғылыми орталықтарды қолдау;

Деректермен қамтамасыз ету: сала бойынша жасанды интеллектпен байланысты деректер жинағын жүйелеу және ашық дерекқор құру;

Кадрлық әлеуетті арттыру: аграрлық және техникалық бағыттағы кадрларды жасанды интеллект технологияларына бейімдеп даярлау.

Қорытындылай келе, жүргізілген салыстырмалы және корреляциялық талдаулар нәтижесінде ауыл шаруашылығында жасанды интеллекті енгізудің экономикалық негізделген қажеттілігі дәлелденді. Қазақстан жағдайында бұл технологиялардың енгізілуі өндіріс тиімділігін арттыру, климаттық тәуекелдерді азайту және азық-түлік жүйесінің тұрақтылығын қамтамасыз етуге әлеуетті әсер ете алады. Сонымен қатар, ста-

тистикалық деректер негізінде инновациялық белсенділік пен инвестициялық белсенділіктің арасындағы өзара байланыс анықталды. Осы нәтижелерге сүйене отырып, ауыл шаруашылығына жасанды интеллектіні кең ауқымда енгізудің институционалдық, инфрақұрылымдық және кадрлық негіздерін дамыту қажеттілігі айқындалды. Жалпы алғанда, жасанды интеллект – агроөнеркәсіптік кешеннің жаңғыруының негізгі драйвері ретінде қарастырылады.

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INTEGRATED MARKETING COMMUNICATION EFFECTIVENESS VALUATION APPROACHES: BIBLIOMETRIC ANALYSIS OF RECENT YEARS

Integrated Marketing Communication (IMC) has emerged as a core element of strategic marketing, particularly in the context of digital transformation and increasing demands for accountability. Despite its centrality in practice, scholarly evaluation of IMC effectiveness remains methodologically diverse and theoretically fragmented. This study aims to systematically analyze how IMC effectiveness has been assessed in peer-reviewed academic literature over the past 34 years (1991–2024). The research seeks to identify dominant theoretical perspectives, categorize key measurement tools, and expose gaps in standardization. To achieve these objectives, a bibliometric analysis was conducted using the Bibliometrix R package. The dataset comprised 410 peer-reviewed articles retrieved from the Scopus database through a structured query focused on IMC effectiveness. The methodology included keyword co-occurrence analysis, co-citation mapping, and trend analysis to reveal thematic clusters, leading contributors, and the intellectual structure of the field. The results identified five major thematic clusters: (1) conceptual foundations, (2) brand equity and consumer behavior, (3) measurement models and return on investment, (4) digital and social media integration, and (5) global and emerging market applications. The findings reveal a progression from conceptual discourse in the 1990s to the emergence of quantitative models and digital engagement frameworks in recent years. Despite this development, a unified evaluation framework remains absent. This study contributes to the advancement of IMC scholarship by synthesizing key trends and offering a foundation for future interdisciplinary research. Practically, the findings underscore the need for context-sensitive, integrative metrics to guide both academic inquiry and managerial decision-making.

Keywords: marketing, communications, effectiveness, engagement, digitalization.

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Интеграцияланған маркетингтік коммуникациялардың тиімділігін бағалау тәсілдері: соңғы жылдардағы библиометриялық талдау

Интеграцияланған маркетингтік коммуникациялар (ИМК) – қазіргі заманғы стратегиялық маркетингтің маңызды бөлігіне айналды. Әсіресе цифрлық өзгерістер үдерісінде және нәтижеге қойылатын талаптар күшейген тұста. Тәжірибеде кеңінен қолданылып жүргенімен, ИМК тиімділігін ғылыми тұрғыда бағалау әдістері қалыптаспаған, теориялық негіздері шашыраңқы күйде қалып отыр. Осы зерттеудің мақсаты – 1991 жылдан 2024 жылға дейінгі аралықта жарық көрген ғылыми еңбектерде IMC тиімділігі қалай бағаланғанын жүйелі түрде сараптау. Зерттеу барысында негізгі теориялық бағыттарды анықтау, бағалау құралдарын жіктеу және стандарттың жетіспеушіліктерін көрсету көзделді. Аталған мақсаттарға жету үшін R бағдарламасындағы Bibliometrix топтамасы қолданылып, библиометриялық талдау жүргізілді. Эмпириялық дереккөз ретінде Scopus базасынан алынған, ИМК тиімділігіне арналған жүйелі іздеу нәтижесінде іріктелген 410 ғылыми мақала пайдаланылды. Әдістемелік тәсілдерге басты ұғымдардың жиілігін талдау, бірге дәйектеу (ко-цитация) желілерін бейнелеу және тақырыптық бағыттардың даму үдерісін саралау кірді. Бұл тәсіл ИМК зерттеулеріндегі зияткерлік құрылымды, жетекші бағыттар мен негізгі авторларды анықтауға мүмкіндік берді. Талдау нәтижесінде бес негізгі тақырыптық жиын топтастырылды: тұжырымдамалық негіздер; бренд пен тұтынушының мінез-құлқы; тиімділікті өлшеу үлгілері мен инвестиция қайтарымы (ROI); цифрлық және әлеуметтік желілерді біріктіру; жаһандық және дамушы нарықтардағы қолдану ерекшеліктері. Зерттеу барысында IMC тиімділігін бағалау тәсілдерінің уақыт ағымымен қалай өзгергені анықталды. Дегенмен, әлі күнге дейін бірыңғай, жалпыға ортақ бағалау жүйесі қалыптаспағаны байқалды. Бұл зерттеу

ғы ғылыми білімді толықтырып, бағыттарды жүйелеу арқылы теориялық үлес қосады. Сонымен қатар, қаржылық, тұтынушылық және цифрлық көрсеткіштерді біріктіретін, нақты жағдайға бейімделген кешенді бағалау үлгілерін әзірлеудің маңыздылығын көрсетіп, басқарушылық шешім қабылдауда да пайдалы ұсыныстар береді.

Түйін сөздер: маркетинг, коммуникациялар, тиімділік, қатысу, цифрландыру.

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Подходы к оценке эффективности интегрированных маркетинговых коммуникаций: библиометрический анализ последних лет

Интегрированные маркетинговые коммуникации (ИМК) стали неотъемлемым элементом стратегического маркетинга, особенно в условиях цифровой трансформации и растущих требований к измеримости эффективности. Несмотря на широкое применение в практике, академическая оценка эффективности ИМК остаётся методологически разнородной и теоретически фрагментированной. Целью настоящего исследования является систематический анализ для последующего определения подходов к оцениванию эффективности ИМК в рецензируемой научной литературе за последние 34 года (1991–2024). Исследование направлено на выявление ведущих теоретических подходов, классификацию ключевых инструментов оценки и определение пробелов в стандартизации. Для достижения поставленных целей был проведён библиометрический анализ с использованием пакета Bibliometrix для языка R. В качестве эмпирической базы использовались 410 рецензируемых научных статей, отобранных из базы данных Scopus по целевому поисковому запросу, ориентированному на эффективность IMC. Методология включала анализ со-встречаемости ключевых слов, анализ цитирования и анализ динамики тематических направлений, что позволило выявить ведущие исследовательские кластеры, ключевых авторов и интеллектуальную структуру области. Результаты анализа выявили пять основных тематических кластеров: (1) концептуальные основы, (2) брендинг и поведение потребителей, (3) модели измерения и оценка рентабельности (ROI), (4) интеграция цифровых и социальных медиа, (5) применение ИМК в глобальном и развивающемся контексте. Несмотря на значительный прогресс, было выявлено, что универсальная модель оценки ИМК пока не сформирована. Исследование вносит вклад в развитие научной базы по ИМК, предлагая систематизированное понимание ключевых тенденций и формируя основу для будущих междисциплинарных исследований. Практическая значимость заключается в необходимости применения контекстуально адаптированных и интегративных метрик для академических и управленческих целей.

Ключевые слова: маркетинг, коммуникации, эффективность, вовлеченность, цифровизация.

Introduction

Integrated Marketing Communication (hereinafter – IMC) emerged in the beginning of 1990s due to the increasingly shattered media landscape and the need for coherent brand messaging across multiple platforms (Kitchen & Schultz, 1999: 21-38). Integrated Marketing Communication (IMC) involves the purposeful coordination of a company's distinct promotional activities such as advertising, public relations, direct marketing, and digital communication in order to create a consistent and reinforcing brand message across all channels (Duncan & Moriarty, 1998:1–13). Researchers have suggested that integration enhances consumer recognition, improves message clarity, and contributes to the development of stronger relationships with stakeholders (Kitchen, 2017: 11–30; Schultz & Kitchen, 2000:17–21).

As IMC gained academic and practical popularity, a growing body of research explored how to measure and evaluate its effectiveness in recent years. Initial theoretical frameworks primarily aimed to demonstrate the conceptual value of IMC (Caywood & Ewing, 1991:295–299). In recent decades, scholars have developed a variety of metrics and analytical frameworks, spanning from econometric modeling of media synergy (Naik & Raman, 2003:375–388) to measurement scales for IMC implementation at the firm level (Porcu et al., 2017: 692–718). Although substantial efforts have been made, developing standardized and universally accepted IMC effectiveness valuation tools remains an ongoing challenge (Kliatchko, 2008: 133–160; Šerić, 2016: 577–597).

Although several narrative reviews and meta-analyses of IMC have been conducted (e.g., Luxton et al., 2015: 37–46; Madhavaram, 2005: 69–80; Schultz & Patti, 2009:75–84), the field still lacks

a comprehensive bibliometric analysis that specifically addresses the evaluation of effectiveness. Specifically, this research systematically delineates the intellectual structure and thematic evolution of IMC effectiveness literature through advanced bibliometric techniques, including keyword co-occurrence analysis, citation and co-citation analysis, and temporal trend mapping. While previous reviews predominantly concentrate on publication growth trajectories, prominent authors, and topic overviews within the IMC domain, they frequently restrict their analysis to select specific journals or geographic regions. Therefore, to address this gap, the present study conducts a comprehensive bibliometric analysis of IMC research published over the past 34 years, using the Scopus database and the Bibliometrix R-package (Aria & Cuccurullo, 2017: 959–975).

The primary objectives are to identify key publication trends, leading authors, influential institutions, and core journals within the IMC domain. The study also examines citation dynamics and co-citation networks to uncover the intellectual structure underpinning IMC effectiveness research. In addition, it highlights dominant themes related to effectiveness measurement tools such as return on investment (ROI), brand equity, synergy modeling, and consumer engagement. Finally, it explores emerging areas of interest, including digital IMC, consumer empowerment, and applications in emerging markets, which represent promising avenues for future investigation.

By offering a systematic, quantitative overview of the IMC literature, this study contributes valuable insights for both scholars and practitioners aiming to enhance evaluation methodologies and advance theoretical understanding of how integrated communication strategies influence market outcomes. The subsequent sections outline the research methodology, present key findings, and propose future research directions.

Literature review

The concept of Integrated Marketing Communication (IMC) is grounded in the understanding that various promotional tools such as advertising, sales promotion, direct marketing, public relations, and personal selling should be strategically aligned to ensure a consistent and cohesive brand message. Early scholarly work emphasized the transition from product-focused, one-way advertising to a holistic framework centered on consumer engagement (Duncan & Moriarty, 1998: 1–13). This evolution was spurred by the fragmentation of media channels and the realization that an undifferentiated, mass communication approach often falls short of delivering sustained brand equity or consumer loyalty (Keller, 2009: 139–155).

Subsequent studies refined this premise by highlighting IMC's strategic function. Rather than viewing IMC merely as a tactical toolset, scholars argued for its integration at the highest organizational levels, linking marketing objectives to corporate goals and embedding IMC principles into cross-functional processes (Kitchen & Schultz, 1999: 21–38; Porcu et al., 2017: 692–718). Adopting this strategic stance positions IMC as a dynamic, iterative process wherein marketing communications do not operate in silos but are continually informed by consumer feedback, competitive analysis, and brand positioning (Kliatchko, 2008: 133–160). Such an approach has proven particularly relevant in contemporary markets, characterized by the rapid proliferation of digital media and the emergence of consumer-centric platforms.

Yet, the diversity of channels and touchpoints complicates IMC implementation, making it essential to develop frameworks that account for stakeholder collaboration, message consistency, and adaptive brand storytelling. As a result, modern IMC discourse increasingly intersects with broader organizational strategies, such as brand orientation, market orientation, and the evolving notion of omnichannel management. This interdisciplinary perspective underscores the multifaceted nature of IMC, positioning it not merely as a communication tactic but as a central tenet in shaping consumer perceptions, driving engagement, and building brand value over time (Luxton et al., 2015: 37–46).

Despite the widespread endorsement of IMC as a best practice, measuring its effectiveness has been fraught with complexity. Traditional performance metrics, such as reach and frequency, struggle to capture the nuanced interactions consumers have with brands across online and offline platforms (Kitchen et al., 2008: 531–546). Researchers have turned to diverse qualitative and quantitative indicators ranging from brand recall and purchase intention to engagement metrics on social media to encapsulate how IMC efforts influence consumer behaviors (Eagle et al., 2007: 956–970).

A prominent debate revolves around the use of financial vs. non-financial metrics for gauging IMC success. While financial metrics like return on investment (ROI) offer straightforward comparisons

for budget allocation, they can oversimplify complex consumer journeys (Naik & Raman, 2003: 375–388). Conversely, non-financial or consumer-centric metrics (e.g., brand equity, customer satisfaction, advocacy) shed light on deeper attitudinal or relational outcomes, yet may lack immediate managerial salience if they do not translate readily into short-term financial returns (Keller, 2009: 139–155). Consequently, IMC researchers advocate a hybrid measurement strategy, one that balances ROI-based models with robust consumer insight data to form a comprehensive evaluation of campaign performance and future brand potential (Smith, 2006: 564–579).

Moreover, recent scholarship emphasizes the role of digital analytics in refining IMC effectiveness measurement (Leeflang, 2014: 1–12). Tools such as multi-touch attribution models, social listening, and sentiment analysis enrich marketing dashboards by unveiling real-time shifts in consumer engagement. However, these approaches also introduce analytical challenges related to data integration, modeling sophistication, and privacy considerations. Consequently, researchers have increasingly highlighted the necessity of systematic frameworks that harmonize traditional performance indicators with newly available digital metrics, ensuring a more accurate portrayal of IMC's overall impact.

Valuation in marketing communications broadly encompasses the frameworks and models that aim to quantify the returns and strategic benefits derived from integrated campaigns. Traditional valuation tools rely heavily on measuring immediate outcomes such as sales lift or market share changes, often through econometric models or controlled experiments. However, such short-term metrics may overlook the long-term effects of IMC on brand equity, consumer loyalty, and other enduring intangible assets, which are becoming increasingly relevant in saturated and highly competitive market environments (Keller, 2009: 139–155).

In response, scholars have advanced a variety of holistic valuation strategies that incorporate brand-building, consumer engagement, and market orientation factors (Porcu et al., 2017: 692–718; Luxton et al., 2015: 37–46). For instance, brand equity models integrate consumer perceptions (awareness, associations, loyalty) with financial indicators (price premiums, revenue growth) to offer a balanced view of communication effectiveness (Keller, 2009: 139–155). Other scholars advocate for the use of integrated dashboards or scorecards, highlighting the importance of cross-functional collaboration and alignment with overarching organizational goals (Smith et al., 2006: 564–579). This aligns with the notion of "IMC capability," which posits that organizations adept at orchestrating integrated campaigns and leveraging internal synergies see higher brand performance and market impact (Luxton et al., 2015: 37–46).

Yet, despite these advancements, a universal consensus on the most robust valuation paradigm remains elusive (Kitchen & Burgmann, 2015: 34– 39). Distinct industry contexts, regional market norms, and technological infrastructures often necessitate bespoke measurement approaches. For example, direct-to-consumer brands may prioritize lifetime customer value metrics, while B2B firms might lean on lead generation and conversion rates. Similarly, consumer-packaged goods companies may emphasize media mix modeling, whereas technology start-ups rely on agile analytics or real-time attribution. This methodological heterogeneity underscores the growing importance of knowledge synthesis and interdisciplinary collaboration in refining valuation tools for IMC.

Considering the breadth and complexity of IMC research, a systematic approach to aggregating and evaluating this body of literature becomes paramount. Traditional narrative reviews, although insightful, may be susceptible to subjective biases and may inadvertently exclude pivotal studies due to the sheer volume of publications (Zupic & Čater, 2015: 429–472). Bibliometric methods, by contrast, employ quantitative techniques to uncover patterns in scholarly output, mapping citation networks, co-authorship structures, and thematic clusters within large datasets (Donthu et al., 2021: 739–759).

For the IMC effectiveness domain, a bibliometric analysis offers a means to chart the intellectual evolution of key topics, pinpoint the most influential works and authors, and identify any emergent areas that may signal future research directions (Kitchen et al., 2008: 531–546). By transforming extensive publication data into visual and statistical representations, this approach can uncover underlying connections between studies, providing insights into how various subthemes such as measurement techniques, the impact on brand equity, and digital IMC are interrelated. Moreover, bibliometric findings can guide practical recommendations by showing whether certain valuation methods have been rigorously tested across diverse contexts or if research efforts remain concentrated in limited sectors (Zupic & Čater, 2015: 429–472).

Thus, the gap in current IMC scholarship lies not merely in advancing new theories or measurement models but in comprehensively mapping and critically assessing the existing literature. A bibliometric review can address this shortfall, providing an evidence-based foundation on which both academics and practitioners can build. In doing so, it responds directly to calls for greater methodological rigor and interdisciplinary integration in IMC research, while also offering strategic direction for future empirical and conceptual studies.

Methodology

This section outlines the methodological framework employed to investigate how the effectiveness of Integrated Marketing Communication (IMC) has been examined within the academic literature over the past three decades. The research design was structured into three principal phases: data collection, data refinement, and bibliometric analysis. In the initial phase, relevant scholarly publications were extracted from the Scopus database using a carefully formulated search query aimed at capturing literature focused on IMC and its evaluation. The second phase involved the systematic cleaning and preparation of the dataset, which included the elimination of duplicates, standardization of author names, harmonization of keywords, and validation of thematic relevance. The final phase consisted of an in-depth bibliometric analysis incorporating descriptive statistical summaries, co-citation analysis, keyword co-occurrence mapping, and collaboration network evaluation. Each phase is discussed in detail in the subsections that follow.

The bibliographic dataset was obtained from the Scopus database and encompasses scholarly publications spanning the period from 1991 to 2024. The year 1991 was selected as the starting point because it marks the formal emergence of IMC as a distinct topic in scholarly discourse. Notably, 1991 saw the first comprehensive study and academic discussions of IMC. For example, Caywood and Ewing's (1991) work introduced IMC as a new marketing communications paradigm. Subsequent literature reviews and bibliometric analyses explicitly identify 1991 as the inception of IMC research, underscoring that meaningful academic inquiry into IMC begins in the early 1990s. By using 1991 as the baseline, the analysis captures the full evolution of IMC scholarship from its very inception. Meanwhile, the cut-off at 2024 was chosen to include the most recent publications and thus encompass roughly three decades of development. This end-point aligns with the approach of prior comprehensive IMC reviews that span multiple decades up to the present era. In sum, the 1991–2024 timeframe enables a longitudinal overview from IMC's introduction in academia through to its contemporary advancements, ensuring the analysis reflects both the foundational work and the latest trends in the field.

Consistent with prior reviews (e.g., Al Mamun, 2022: 4–27), the utilized search queries incorporate terms such as "Integrated Marketing Communication", "integrated marketing communications", "IMC effectiveness", and "IMC measurement". Therefore, to identify the most relevant literature, the research applied a search string KEY ("Integrated Marketing Communication" OR "integrated marketing communications" OR "IMC effectiveness" OR "IMC measurement"). The inclusion criteria encompassed peer-reviewed journal articles, conference proceedings, and scholarly book chapters. The initial search resulted in the retrieval of 449 bibliographic records.

During the research, the Bibliometrix R-package (Aria & Cuccurullo, 2017: 959–975) was used to remove duplicates and standardize author names and keywords. In total, 39 records were excluded due to duplication or irrelevance, resulting in a final dataset of 410 documents. Bibliometrix functions were used to unify variations in author names (e.g., "Kitchen, P.J." and "Phillip J. Kitchen"), to merge synonymous keywords ("Integrated Marketing Communication" vs. "IMC"), and to extract citation and reference metadata.

In accordance with established guidelines in bibliometric scholarship, a series of complementary analyses was conducted to systematically address the research objectives:

Descriptive Analysis: The analysis began by investigating longitudinal publication trends to assess the temporal growth trajectory of IMC scholarship. Annual publication frequencies were calculated to reveal patterns in research output over time, while aggregated yearly citation counts were used to evaluate the evolving scholarly influence of the field. This examination offers insight into whether IMC research has reached a saturation point or continues to expand. In addition, the study identified the most prolific contributors at the author, institutional, and national levels. Measures such as total citation counts and h-index values were employed to evaluate both productivity and scholarly impact within the IMC literature.

Co-citation Analysis: To examine the intellectual structure of IMC effectiveness research, a co-citation analysis was conducted using the reference lists of 410 publications. A co-citation matrix was developed, where each cell reflected how frequently two documents were cited together. Based on this matrix, a network analysis was performed, and the Louvain community detection algorithm was applied to identify cohesive thematic clusters. A hierarchical clustering dendrogram based on co-citation distances further supported the interpretation of cluster boundaries. Key publications within each cluster were reviewed to determine thematic focus. For example, a cluster including Schultz (1997) and Duncan and Moriarty (1998) was interpreted as representing the conceptual foundations of IMC. The resulting clusters reveal intellectual sub-structures in the field, illustrating how scholars tend to co-cite foundational works around shared topics or theoretical perspectives. Clusters of highly co-cited papers indicated thematic lines of inquiry, particularly those on IMC effectiveness.

Keyword Co-occurrence Analysis: To identify prevailing research themes and emerging areas of inquiry within the IMC literature, a keyword co-occurrence analysis was performed. A co-occurrence network was constructed in which nodes represented standardized keywords and edges denoted their joint appearance within individual publications. To enhance interpretability and reduce noise, the network was pruned by excluding keywords below a predefined frequency threshold. The association strength normalization technique was applied, followed by the implementation of the Louvain algorithm to detect clusters of frequently co-occurring terms. Each resulting cluster delineates a thematic domain within the broader IMC research landscape. For instance, a grouping of terms such as "brand equity," "consumer engagement," and "psychology" points toward a research stream focused on consumer behavior and brand-related outcomes in integrated marketing contexts. Furthermore, a two-dimensional thematic map was produced via correspondence analysis using the Bibliometrix package, enabling the classification of clusters based on their centrality (indicating importance within the field) and density (reflecting internal cohesion and development). This mapping facilitated the categorization of themes as motor themes (central and mature), niche themes (specialized but peripheral), and emerging or declining themes (low centrality and density, suggesting early-stage or diminishing interest). Owing to spatial constraints, the findings from the cluster analysis are primarily conveyed through narrative interpretation and tabular summaries.

Collaboration Analysis: The study also explored patterns of scholarly collaboration by analyzing co-authorship networks and geographic distribution. Mapping co-authorship relationships enabled the identification of interconnected research communities and the degree of collaboration among individual scholars. In parallel, a geographical analysis was conducted to assess regional contributions to IMC effectiveness research and to determine whether scholarly activity is concentrated within specific national contexts or dispersed across international partnerships. Although not the primary focus of the study, examining the structure and density of collaborative networks offers valuable contextual insight. For example, the presence of a tightly connected cluster of researchers within a single country may suggest the existence of a coordinated national agenda or institutional emphasis on IMC effectiveness.

All analyses were conducted using R (version 4.0), with the majority of computations performed through the Bibliometrix package. Core functions included biblioAnalysis, networkPlot, and conceptualStructure for thematic mapping. VOSviewer (version 1.6) was also utilized to validate network visualizations and assess the consistency of clustering results. Clustering parameters, including the resolution value in the Louvain algorithm and the number of clusters, were selected based on established methodological conventions and refined through iterative testing to enhance interpretability. For example, several resolution levels were evaluated to prevent excessive fragmentation, which ultimately yielded five meaningful keyword clusters. Quality control procedures were applied, such as verifying that key outcomes, including the identification of the most frequently cited publications, were not disproportionately affected by outliers or anomalies. Additionally, checks ensured that the keyword normalization process preserved conceptual distinctions between terms. The results of these procedures are presented in the next section, accompanied by visual outputs such as network diagrams and dendrograms, along with summary tables. Together, these methods provide a transparent and replicable overview of the IMC effectiveness literature.

Results and discussion

Between 1991 and 2024, the corpus of Integrated Marketing Communication (IMC) literature has exhibited a sustained upward trajectory, marked

by pronounced accelerations in the early 2000s and again in the late 2010s. Quantitative analysis reveals that the mean annual output during 2001–2005 increased by approximately 60 percent relative to the preceding quinquennial interval, reflecting the formalization and institutional consolidation of IMC as a distinct research domain (Schultz & Kitchen, 2000: 17–21). The most dramatic expansion occurred after 2010, driven in part by the proliferation of digital marketing channels and a burgeoning scholarly focus on multi-channel integration frameworks (Batra & Keller, 2016: 122–145; Mangold & Faulds, 2009: 357–365). According, to Figure 1, the annual volume of IMC-related publications from 1991 to 2024 demonstrates a generally upward trend, marked by two distinct periods of accelerated growth.

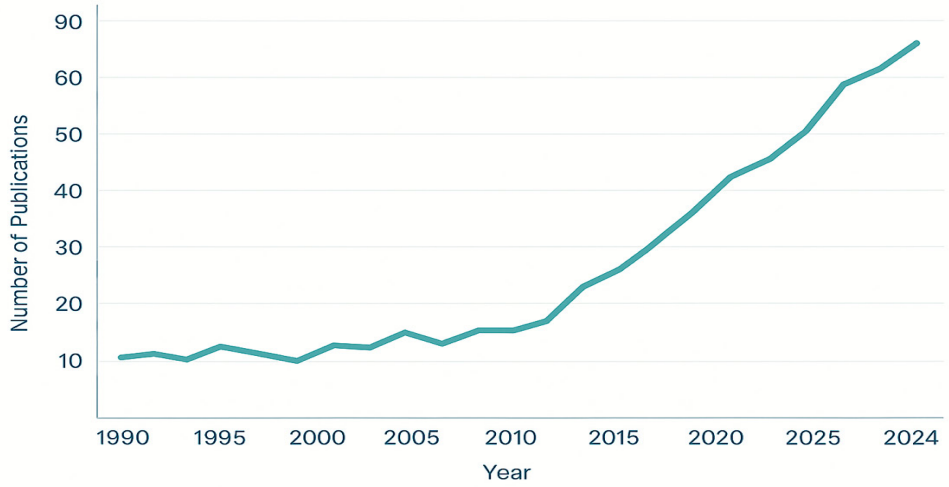

Figure 1 – Annual publication output on IMC from 1991 to 2024
Note – compiled by authors based on Scopus database

The most substantial increase in IMC-related publications occurred during the 2010s, with a marked acceleration beginning after 2010. Between 2011 and 2015, the number of publications approximately doubled relative to the 2006–2010 period, followed by a continued upward trajectory from 2016 onward. By 2021, the annual output had expanded by an order of magnitude compared to the early 1990s. This surge corresponds with the broader digital transformation, during which the integration of social and mobile media into marketing communication strategies became a critical area of inquiry. In total, 410 publications were included in the analysis, with more than half appearing within the last decade, underscoring a sustained and growing scholarly focus on IMC effectiveness.

In parallel with the rise in publication volume, citation counts have also increased, although they exhibit a strong concentration around a limited number of seminal contributions. The mean citation count per document within the dataset is approximately 20; however, this figure is substantially influenced by a small subset of highly cited publications (see Table 1).

Table 1 presents the five most frequently cited publications within the analyzed corpus of IMC research. Leading the list is the influential article by Mangold and Faulds (2009), which has amassed over 4,700 citations and is widely recognized for its pivotal role in incorporating social media into the IMC conceptual framework. Other highly cited works include Batra and Keller (2016), which offers a reconceptualization of IMC in the context of digital marketing, and Naik and Raman (2003), whose econometric model of media synergy serves as a foundational reference in empirical assessments of IMC effectiveness. Seminal studies connecting IMC to brand-related outcomes, such as Madhavaram et al. (2005) on brand equity and Luxton et al. (2015) on IMC capabilities and organizational perfor-

mance, complete the top five. The visibility and impact of these publications reflect the field's emphasis on digital integration and methodological rigor in measuring communication outcomes. To further contextualize the evolution of IMC scholarship, it is important to identify the most prolific contributors to the literature. Examining these key authors provides insight into dominant research agendas, theoretical orientations, and methodological trends that have shaped the discourse over time (see Table 2).

Table 1 – Top five cited IMC publications from 1991 to 2024

Study	Topic	Total Citations
Mangold & Faulds (2009, Business Horizons)	Social media's role in IMC	4736
Batra & Keller (2016, Journal of Marketing)	Reframing IMC in a digital era	1242
Naik & Raman (2003, Journal of Marketing Research)	Synergy in multimedia communications	842
Madhavaram et al. (2005, Journal of Advertising)	IMC & brand identity; brand equity link	726
Luxton et al. (2015, Journal of Advertising)	IMC capability & brand performance	433
Note – compiled by authors based on Scopus database		

Table 2 – Top Five Most Prolific Authors in IMC Research

Author	Publications	Citations	Key Contributions
Philip J. Kitchen	15	430	IMC theory & definitions; global IMC adoption
Don E. Schultz	10	520	Early IMC pioneer; measurement & accountability
Marija Šerić	9	125	Empirical IMC trends; tourism/hospitality IMC
Lluís Porcu	8	105	IMC measurement scales; organizational IMC
Michael Reid	7	295	IMC & brand orientation; market orientation
Note – compiled by authors based on Scopus database			

Table 2 presents the five most prolific authors in the field of IMC, based on publication volume, total citations, and thematic focus. Philip J. Kitchen and Don E. Schultz occupy the top positions, which aligns with their widely recognized status as foundational figures in the development of IMC theory and practice. Kitchen, with 15 publications, and Schultz, with 10, contributed extensively to the early conceptualization of IMC and its diffusion across international contexts. Schultz, often in collaboration with Kitchen, also played a pivotal role in advocating for the standardization of IMC evaluation, emphasizing the importance of return on investment (ROI) metrics and performance-based accountability. Their scholarly impact is further reflected in their citation metrics, with Kitchen's contributions accumulating approximately 430 citations and Schultz's works nearing 520 within the dataset. These figures underscore their enduring influence on the intellectual and methodological evolution of IMC research.

The bibliometric investigation identified a set of distinct thematic clusters that delineate the intellectual contours of the IMC effectiveness literature. Two complementary analytical techniques were employed to uncover these patterns: a keyword co-occurrence analysis, which highlights the principal research themes based on term frequency and association, and a co-citation analysis, which reveals the foundational works and intellectual linkages underlying those themes. The findings from both methods are examined in parallel to provide an integrated overview of the field's conceptual and theoretical development (see Figure 2).

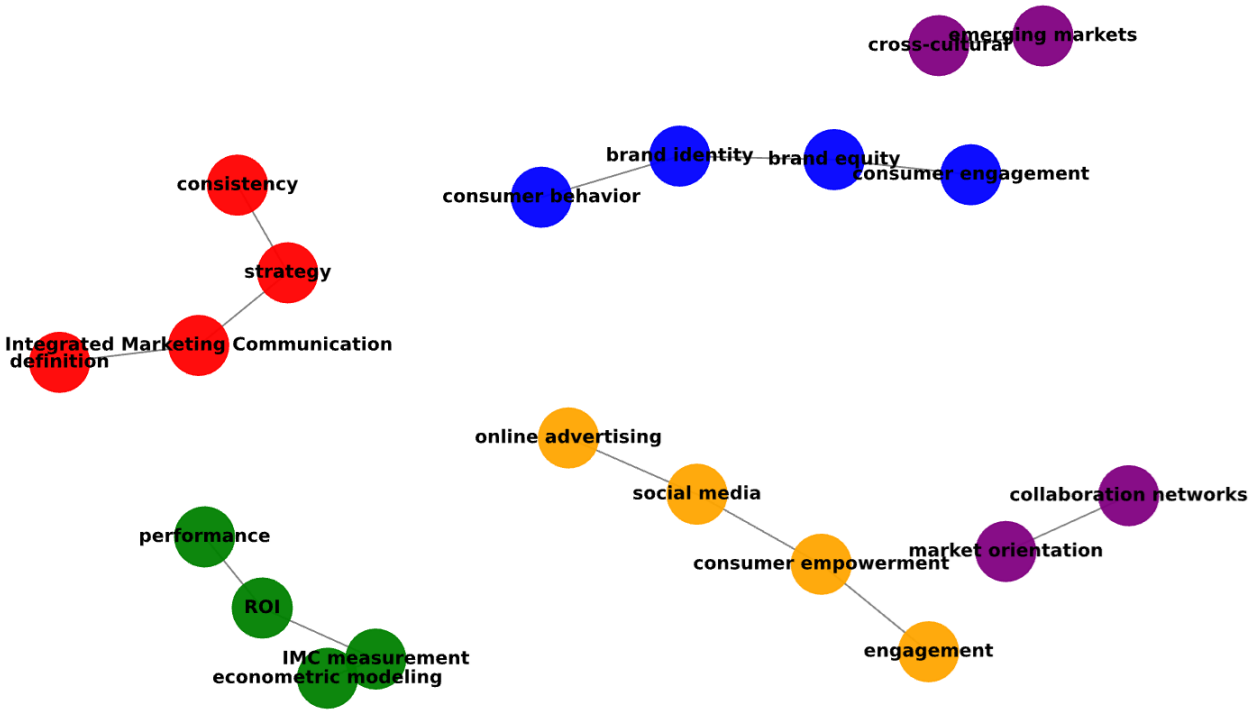

Figure 2 – Keyword co-occurrence network of IMC research
Note – compiled by authors

Figure 2 displays the keyword co-occurrence network, in which nodes represent frequently occurring terms, and the colors indicate clusters of keywords that commonly appear in conjunction across the literature. The analysis revealed five primary thematic clusters, each reflecting a distinct area of focus within IMC research. Specifically, the red cluster pertains to "Conceptual Foundations and the Definition of IMC", the blue cluster captures themes related to "Branding and Consumer Psychology", the green cluster is associated with "Measurement and Evaluation", the orange cluster highlights topics within "Digital IMC and Interactive Media", and the purple cluster reflects scholarship on "Global and Emerging Markets". These thematic groupings emerged from both the co-occurrence network structure and the supporting bibliometric evidence.

Cluster 1: Conceptual Foundations and the Definition of IMC (Red nodes).

This cluster is centered around broad strategic terminology, including "Integrated Marketing Communication", "strategy", "definition", and "consistency". It reflects a foundational body of scholarship aimed at conceptualizing IMC, articulating its theoretical underpinnings, and establishing the rationale for integration across communication channels. These contributions have played a critical role in shaping the discourse and providing a basis for subsequent empirical investigations into IMC effectiveness.

Cluster 2: Branding and Consumer Psychology (Blue nodes).

This thematic group is characterized by recurring terms such as "brand equity," "brand identity," "consumer engagement," and "consumer behavior." It represents a body of literature that links IMC to consumer psychology and brand management. Studies within this cluster frequently explore how integrated communication strategies influence brand perception and consumer relationships. Research designs often include experimental methods, survey-based analyses, and brand equity modelling, with a focus on assessing IMC success through consumer attitudes, behavioral responses, and branding outcomes.

Cluster 3: Measurement and Evaluation (Green nodes).

This cluster encompasses terms such as "performance", "return on investment (ROI)", "IMC measurement", "econometric modeling", and "social media metrics". It reflects a thematic concentration on the formulation and use of quantitative methods

for evaluating the effectiveness of IMC. Research in this area frequently introduces structured evaluation frameworks, including financial indicators, scoring systems, and customer equity metrics. These studies commonly draw on empirical data to demonstrate how communication integration contributes to measurable outcomes. Overall, this cluster represents the methodological foundation of IMC effectiveness research.

Cluster 4: Digital IMC and Interactive Media (Orange nodes).

Key terms in this cluster include "social media", "online advertising", "digital", "consumer empowerment", and "engagement". While the term "engagement" overlaps with Cluster 2, its application here pertains specifically to digital environments. This cluster encapsulates the literature focused on integrating IMC across digital platforms, emphasizing two-way communication and the participatory role of consumers. Topics include harmonizing traditional and digital messaging, leveraging user-generated content, and addressing challenges of consistency across digital touchpoints. The presence of "consumer empowerment" suggests a growing recognition of consumers as active contributors to brand narratives in digitally mediated environments.

Cluster 5: IMC in Global and Emerging Markets (Purple nodes).

This cluster comprises terms such as "cross-cultural", "emerging markets", "market orientation", and "collaboration networks". Although heterogeneous, the unifying thread is the contextualization of IMC practices within diverse cultural and economic environments. Studies in this area investigate how integration strategies vary across geographic regions and organizational settings, with particular attention to contrasts between developed and developing markets. This cluster highlights the field's increasing interest in understanding how IMC effectiveness is shaped by institutional, cultural, and structural variables on a global scale.

The co-citation network, represented through a hierarchical dendrogram, confirmed the presence of three overarching clusters within the IMC literature (see Figure 3).

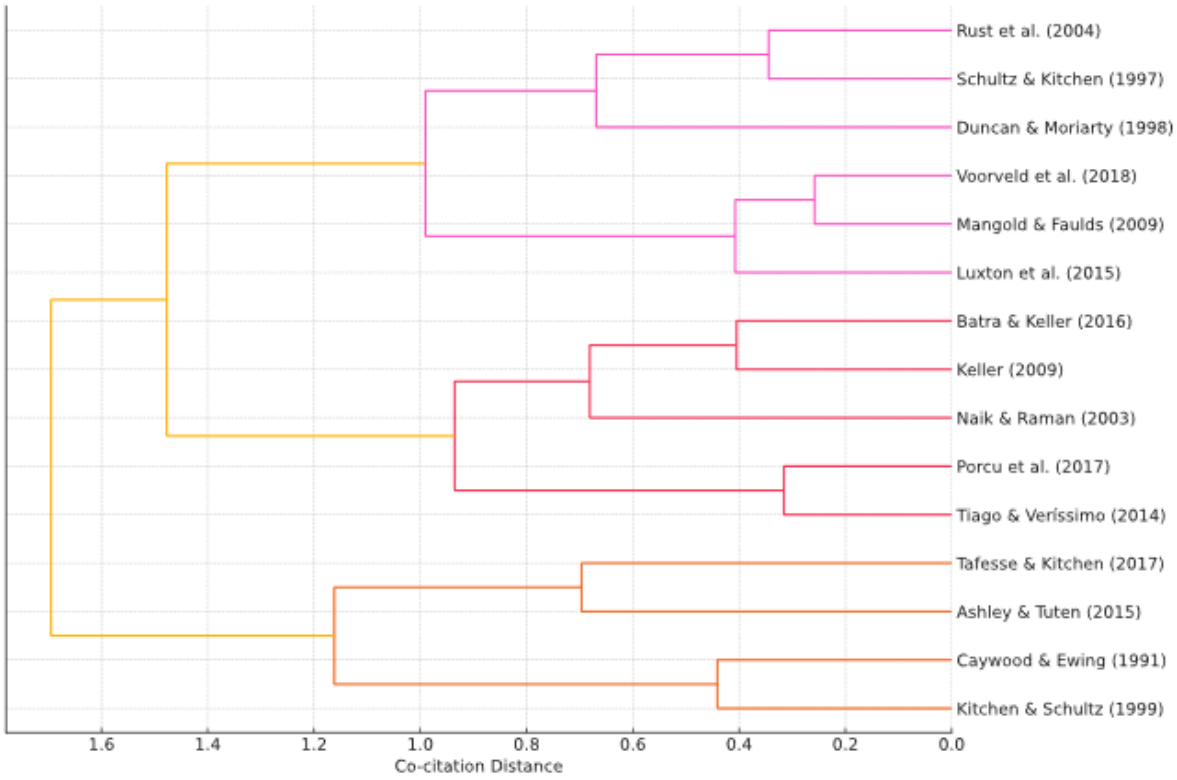

Figure 3 – Dendrogram of co-cited references in IMC research
Note – compiled by authors
Interpretation of the dendrogram and associated co-citation clusters:

Cluster A: Conceptual Foundations This cluster encompasses foundational literature predominantly published in the 1990s. Frequently co-cited works include Schultz and Kitchen (1997), Kitchen and Schultz (1999), Duncan and Moriarty (1998), and Caywood and Ewing (1991), among others. These sources are often referenced together in subsequent publications addressing the theoretical underpinnings of IMC, particularly its definition, scope, and strategic rationale. This grouping reflects the early scholarly efforts to establish IMC as a distinct field within marketing communications.

Cluster B: Quantitative Models and Measurement A second cluster aggregates literature from the early 2000s that introduced formalized, data-driven approaches to assessing IMC effectiveness. Central co-cited references in this grouping include Naik and Raman (2003), Rust et al. (2004), Schultz and Patti (2009), and Luxton et al. (2015). These studies are frequently cited in research focused on evaluating IMC performance through metrics such as return on investment, brand impact, and econometric modeling. The prominence of this cluster underscores the methodological advancement of the field toward measurable and accountable communication strategies.

Cluster C: Digital Media and Consumer Engagement The third cluster comprises literature emerging primarily in the late 2000s and 2010s that addresses the integration of digital technologies and evolving consumer roles within IMC. Notable co-cited works in this category include Mangold and Faulds (2009), Batra and Keller (2016), Ashley and Tuten (2015), Tiago and Veríssimo (2014), and Tafesse and Kitchen (2017). These references are commonly cited in contemporary studies examining topics such as social media strategy, content-driven engagement, and the participatory dynamics of consumers in shaping brand communications. This cluster reflects the field's increasing orientation toward interactive media and digital transformation.

Table 3 provides a synthesis of the principal thematic clusters within IMC effectiveness research, tracing the evolution of focal areas over time and linking each to representative scholarly contributions and associated outcome measures.

Table 3 – Major research themes in IMC effectiveness literature for 1991–2024

Theme & Period	Focus Areas (Keywords)	Representative Works (Examples)	Insights on IMC Effectiveness
Conceptual Foundations (1990s)	IMC definitions; strategy; message consistency; organizational adoption	Schultz & Kitchen (1997); Duncan & Moriarty (1998); Kitchen & Schultz (1999)	Articulated *why* integration matters; proposed that consistency leads to better brand understanding (mostly conceptual arguments, little quantitative evaluation)
Branding & Consumer Psychology (ongoing)	Brand equity; brand identity; consumer behavior; engagement (general)	Keller (2009); Madhavaram et al. (2005); Batra & Keller (2016)	Demonstrated IMC's role in building brand value and relationships; measured outcomes like brand equity, customer satisfaction as proxies for IMC effectiveness
Measurement & ROI (2000s)	Performance metrics; ROI; synergy models; IMC implementation scales	Naik & Raman (2003); Rust et al. (2004); Porcu et al. (2017)	Developed models and metrics to quantify IMC impact (e.g., sales lift from synergy, ROI%); introduced firm-level IMC capability measures predicting performance
Digital Integration (2010s)	Social media; online advertising; content marketing; consumer empowerment	Mangold & Faulds (2009); Ashley & Tuten (2015); Voorveld et al. (2018)	Expanded IMC to interactive channels; identified new effectiveness criteria (social engagement, viral reach); highlighted need for real-time and platform-specific measurement in IMC
Global & Cross-cultural (2010s)	Cross-cultural campaigns; emerging markets; global IMC strategies; collaboration	Kliatchko & Schultz (2014); Okazaki & Taylor (2013); Tafesse & Kitchen (2017)	Examined IMC in diverse contexts; suggested that cultural differences moderate IMC effectiveness; stressed internal collaboration and market orientation as factors in successful IMC execution
Note – compiled by authors			

Table 3 consolidates the principal thematic clusters in IMC effectiveness research spanning the period from 1991 to 2024, offering a reflective overview of the field's development. One notable trend is the centrality of digital integration, with social media and engagement metrics now playing a critical role in the evaluation of IMC outcomes. Although measurement approaches have become more diverse, the absence of a universally accepted evaluative framework persists. The literature increasingly draws on interdisciplinary methodologies, including econometric modeling and marketing analytics, and emphasizes the necessity of context-specific strategies, particularly within global and business-to-business environments. These findings suggest that while IMC has matured as a field, it remains theoretically and methodologically fragmented, highlighting the need for continued synthesis and practical alignment.

The following section synthesizes these insights to draw key conclusions and propose directions for future research. It demonstrates how the findings support broader trends, such as the field's shift toward data-intensive and analytically grounded approaches. The discussion also considers implications for practice, including the growing importance of integrated analytics capabilities for organizations seeking to evaluate and optimize IMC strategies. Furthermore, the paper reflects on current limitations, such as the predominance of English-language and United States–based scholarship, which, although still influential, is beginning to shift. By explicitly linking the empirical results, particularly the thematic clusters and observed patterns, to the study's conclusions and recommendations, this section aims to enhance the interpretive clarity of the analysis and respond to previously identified gaps in connecting findings to broader implications.

Conclusion

After three decades of scholarly development, Integrated Marketing Communication (IMC) has evolved from an emerging concept into a foundational element of strategic marketing thought. However, evaluating the effectiveness of IMC remains a complex and multifaceted challenge. This bibliometric analysis traces the intellectual progression of IMC effectiveness research, revealing a transition from conceptual advocacy to empirically grounded, data-informed investigation. While integration continues to be a core component of marketing strategy, the indicators used to assess its effectiveness vary considerably across the literature.

Several key conclusions can be drawn from the findings:

IMC effectiveness research has become increasingly mature and diverse. The steady rise in publication output and citation volume indicates that IMC has been firmly established as a legitimate domain of academic inquiry. Earlier studies were predominantly conceptual, focusing on the rationale for communication integration. More recent contributions have emphasized empirical approaches, introducing measurement scales, econometric models, and real-world case studies to evaluate communication outcomes. There is growing evidence that effective IMC implementation contributes to outcomes such as stronger brand equity, improved customer relationships, and enhanced marketing return on investment. At the same time, the field has become segmented into subfields, as reflected in the cluster analysis, which identified distinct thematic areas including digital environments, global applications, and managerial perspectives. While this diversity demonstrates intellectual vitality, it also suggests that insights are often isolated within thematic silos. Advancing a more unified theory of IMC effectiveness will require greater integration of perspectives across these subdomains.

Digital transformation has redefined how IMC success is assessed. A consistent pattern across the findings is the growing prominence of digital and social media in shaping IMC strategies and evaluation criteria. Traditional measures, such as reach and frequency, are no longer sufficient in isolation. They are increasingly being complemented by metrics that capture engagement, sharing behavior, and continuity across platforms. Influential studies by Mangold and Faulds (2009) and Batra and Keller (2016) underscore how consumer interaction and cross-platform consistency have emerged as critical indicators of success. In practical terms, this means that modern IMC campaigns are often judged by social media sharing rates, multichannel conversion paths, and the overall fluidity of the customer journey rather than by single-channel performance metrics.

Measurement and accountability remain unresolved concerns. Despite methodological progress, the field has yet to coalesce around a universally accepted approach to evaluating IMC performance. This persistent gap is evident in the existence of a distinct thematic cluster devoted to measurement-related research. Although scholars have developed numerous tools, including return on investment models, synergy assessments, and IMC audit instruments, the diversity of approaches has led to incon-

sistencies in the literature. These variations make it difficult to compare findings across studies or to build a cumulative body of knowledge. Addressing this issue will require efforts toward standardizing key metrics and developing robust evaluation frameworks that can be adapted across contexts.

Contextual variability significantly influences IMC effectiveness. IMC strategies and their outcomes are shaped by the specific cultural, industrial, and organizational settings in which they are implemented. What constitutes effective communication in one context may be ineffective or even counterproductive in another. For instance, consumer-facing industries may rely heavily on coordinated media and retail campaigns, while business-to-business environments may prioritize content marketing and relationship-building initiatives. Furthermore, cross-cultural studies reveal that local communication norms, media preferences, and consumer expectations must be accounted for when designing and assessing IMC efforts. Both researchers and practitioners are advised to adopt context-sensitive approaches, including more comparative and cross-national research designs. The growing internationalization of IMC scholarship supports this direction and will help identify which principles are universally applicable and which are context-specific.

The future of IMC research lies in methodological and disciplinary integration. To remain relevant, IMC research must reflect the integrative principles it promotes. The increasing relevance of digital technologies, the rise of data-driven strategies, and the expansion into global markets all demand interdisciplinary collaboration. The study of marketing communication can no longer be divorced from technological innovation, cultural analysis, or financial performance evaluation. future advances in IMC assessment are likely to emerge from the convergence of multiple fields. For example, artificial intelligence can be used to optimize media allocation, and social network analysis can provide new insights into message diffusion. The bibliometric analysis indicates that such convergence is already underway, as evidenced by the expanding diversity of keywords and referenced disciplines. Scholars are encouraged to engage in cross-disciplinary research and to adopt mixed-method approaches. Practitioners are similarly advised to assemble teams that combine marketing expertise with data science, cultural intelligence, and strategic communication planning.

Future research should prioritize the creation of a comprehensive IMC effectiveness framework that integrates financial, behavioral, and operational metrics validated across industries, markets, and campaign types. Additional focus should be placed on longitudinal analysis, the application of emerging technologies such as artificial intelligence and immersive media, and the strengthening of academic-industry partnerships. Such efforts will ensure that IMC research continues to offer theoretically sound and practically relevant insights.

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ARTIFICIAL INTELLIGENCE-BASED RISK MANAGEMENT FOR THE BANKING SECTOR: IMPACT AND CHALLENGES

The aim of this study is to comprehensively examine the impact of artificial intelligence (AI) technologies on risk management in the banking sector. The research focuses on how machine learning, natural language processing, and predictive analytics enhance credit scoring, fraud detection, and regulatory compliance. A mixed-method approach was applied, including a systematic literature review, machine learning based analysis of open banking datasets (Kaggle), and a survey of 200 bank employees in the Middle East. The findings demonstrate that ensemble models such as XGBoost and Random Forest significantly outperform traditional techniques in prediction accuracy and classification efficiency. The scientific novelty lies in the development of a comprehensive framework for integrating AI into banking risk management systems while addressing ethical and regulatory concerns, practices, and minimize financial losses.

Furthermore, the study identifies key challenges, including data privacy concerns, model interpretability, and regulatory constraints, that may hinder the effective integration of AI in banking. The research concludes that AI-driven models have the potential to revolutionize financial risk governance by enabling proactive, data-driven decision-making and fostering operational resilience. Strategic recommendations are provided to guide financial institutions and policymakers in implementing ethical and secure AI frameworks for sustainable innovation.

Keywords: artificial intelligence, risk management, the financial health of banks, machine learning decision-making, banking sector.

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Банк секторында жасанды интеллект негізінде тәуекелдерді басқару: әсері және мәселелері

Бұл зерттеудің мақсаты – жасанды интеллект (AI) технологияларының банк секторындағы тәуекелдерді басқаруға әсерін жан-жақты зерттеу. Зерттеу машиналық оқыту, табиғи тілді өңдеу және болжамды талдау несиелік скорингті, алаяқтықты анықтауды және нормативтік талаптарға сәйкестікті қалай жақсартатынына бағытталған. Жүйелі әдебиеттерді шолуды, ашық банктік деректер жиынын машиналық оқытуға негізделген талдауды (Kaggle) және Таяу Шығыстағы 200 банк қызметкерінің сауалнамасын қамтитын аралас әдіс тәсілі қолданылды. Нәтижелер XGBoost және Random Forest сияқты ансамбльдік модельдер болжау дәлдігі мен жіктеу тиімділігі бойынша дәстүрлі әдістерден айтарлықтай асып түсетінін көрсетеді. Ғылыми жаңалық этикалық және реттеу мәселелерін шешу кезінде АИ-ді банктік тәуекелдерді басқару жүйелеріне біріктіру үшін кешенді негізді әзірлеуде жатыр. Зерттеудің практикалық маңыздылығы оның қаржы жүйесінің тұрақтылығын арттыру, тәуекелдерді бағалау тәжірибесін жақсарту және қаржылық шығындарды азайту үшін қаржы институттары мен реттеушілер үшін қолдану мүмкіндігінде.

Сонымен қатар зерттеу деректердің құпиялылығы мәселелерін, үлгінің интерпретациялануын және реттеуші шектеулерді қоса алғанда, AI-ның банк ісінде тиімді интеграциясына кедергі келтіруі мүмкін негізгі қиындықтарды анықтайды. Зерттеу AI басқаратын модельдер проактивті, деректерге негізделген шешімдер қабылдауға және операциялық тұрақтылықты арттыруға мүмкіндік беру арқылы қаржылық тәуекелдерді басқаруда төңкеріс жасау мүмкіндігіне ие деген

қорытындыға келеді. Стратегиялық ұсынымдар қаржылық институттар мен саясаткерлерге тұрақты инновациялар үшін этикалық және қауіпсіз AI негіздерін енгізуге бағытталады.

Түйін сөздер: жасанды интеллект, тәуекелдерді басқару, банктердің қаржылық сақтандырылуы, машиналық оқыту, шешім қабылдау, банк секторы.

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Управление рисками на основе искусственного интеллекта в банковском секторе: влияние и проблемы

Целью данного исследования является всестороннее изучение влияния технологий искусственного интеллекта (ИИ) на управление рисками в банковском секторе. Исследование сосредоточено на том, как машинное обучение, обработка естественного языка и предиктивная аналитика улучшают кредитный скоринг, обнаружение мошенничества и соблюдение нормативных требований. Был применен смешанный подход, включая систематический обзор литературы, основанный на машинном обучении анализ открытых банковских наборов данных (Kaggle) и опрос 200 банковских служащих на Ближнем Востоке. Результаты показывают, что ансамблевые модели, такие как XGBoost и Random Forest, значительно превосходят традиционные методы по точности прогнозирования и эффективности классификации. Научная новизна заключается в разработке комплексной структуры для интеграции ИИ в системы управления банковскими рисками с учетом этических и нормативных проблем. Практическая значимость исследования заключается в его применимости для финансовых учреждений и регулирующих органов для повышения стабильности финансовой системы, улучшения практики оценки рисков и минимизации финансовых потерь.

Кроме того, исследование выявляет ключевые проблемы, включая проблемы конфиденциальности данных, интерпретируемость моделей и нормативные ограничения, которые могут препятствовать эффективной интеграции ИИ в банковское дело. Исследование приходит к выводу, что модели на основе ИИ могут произвести революцию в управлении финансовыми рисками, обеспечивая проактивное принятие решений на основе данных и способствуя операционной устойчивости. Предоставляются стратегические рекомендации для финансовых учреждений и политиков по внедрению этических и безопасных фреймворков ИИ для устойчивых инноваций.

Ключевые слова: искусственный интеллект, управление рисками, принятие решений, машинное обучение, банковский сектор.

Introduction

Effective risk detection, evaluation, and mitigation techniques are vital to ensuring financial stability and protecting client deposits since lending money carries a high default risk and market swings may have an important impact on consumers financial health. As a result, the banking industry heavily depends on strong risk management frameworks. The first phases in risk management in banking are risk identification, assessment, and prioritization. After that, concerted efforts are undertaken to lessen, monitor, and control the possibility or impact of adverse events. Conventional risk management techniques mostly rely on past performance and human judgment, both subject to bias and error. AI provides a more accurate and dynamic approach to risk management because of its capacity to process enormous volumes of data and spot intricate patterns. Banks may improve overall risk mitigation strategies, accelerate decision-making, and more precisely predict future risks by adopting AI-driven models (Gautam, 2023, p.9).

Because banks are subject to an array of risks, involving borrower defaults, noncompliance with short-term obligations, market value fluctuations, internal process errors, and noncompliance with laws and regulations, it is essential to understand the different types of bank risks- credit, market, liquidity, operational, and compliance risk-as well as the significance of having a sound structure (Naeem, 2025). Thus, a well-structured risk management system enables banks to identify potential risks in advance, analyze their severity and probability, implement appropriate controls to mitigate them and continuously monitor their effectiveness. Also, the key points of risk management include the components of the risk management system. These are risk identification, risk assessment, risk mitigation, risk monitoring, risk reporting (Lion, 2024, p.83).

AI's development as a revolutionary tool in a number of sectors, including finance:

Due to its capacity to provide highly automated and data-driven decision-making, AI is rapidly transforming the financial sector.

This leads to increased efficiency, personalized customer experiences, and improved risk management across various financial applications, such as trading, investment advisory, fraud detection, and customer service (Hassan, 2023, p.112).

Essential routes algorithmic trading, risk, assessment, and credit scoring, fraud detection, chatbots and customer support, robo-advisor, market analysis and prediction, compliance, and reports to regulators are some of the ways artificial intelligence is influencing the financial industry. The advantages of AI in finance encompass enhanced efficiency and precision in banking operations, tailored services, improved transaction correctness, expedited decision-making, and the creation of novel business opportunities (Brown, 2024,p.26).

Ai has an enormous effect on the banking sector in addition to it's well known role in risk management. It improves operational efficiency, changes customer service, and directs data-driven decision-making in a number of financial operations sectors.

This streamlines internal procedures and increases the efficiency and personalization of the client experience. AI having a big impact on banking, according to Grand view studies (GVR) and Allied Market Research (AMR).

The value of the banking AI sector grew from $12.9 billion in 2020 to an incredible $193,63 billion in 2023, and it is expected to keep on expanding, potentially reaching new heights by 2030. This expansion is driven by a compound annual growth rate (Cagr) of 37,3 % from 2023 to 2030. By empowering banks to compete with Fintech companies in the digital age, artificial intelligence is transforming the banking sector.

According to a 2020 study by National Business Research Institute and Narrative Science, 32 % of banks have implemented AI technologies, including speech recognition and predictive analytics, to gain a competitive edge. AI has the potential to increase revenue significantly across several banking sectors, with corporate and retail banking expected to benefit the most. These industries stand to gain an estimated $321 billion and $306 billion in value, respectively, from successful AI implementations (Rolando, 2024a). Machine learning is the most popular AI application in investment banking, with a 60% to 80% utilization rate. Predictive analytics and virtual assistant technologies rank second and third, respectively. Generative artificial intelligence (GenAI) is a powerful force that might provide between $200 and $340 billion to the value of the banking industry when taking into account its business environment.

This amount corresponds to 3% to 5% of the industry's overall income, and the banking sector has seen a 9% to 15% boost in profits following the effective implementation of GenAI. In 2023, complaints about point-of-sale problems and unauthorized withdrawals increased by 30%, according to the Consumer Financial Protection Bureau (CFPB). Furthermore, according to a Marketing Standards Board (MSB) poll, 40% of consumers think that unsustainable marketing techniques cause business scandals and marketing inefficiency. Additionally, according to research by the Customer Service Institute (CSI), 50% of consumers have dealt with banking companies, and 60% have met subpar employee attendance policies and bad client relationship management. In growing economies, addressing frequent consumer complaints regarding subpar employee attendance procedures and bad client relationship management becomes essential. AI can improve efficiency and personalization in the customer support process. As a result, marketing results may improve, and consumer happiness and loyalty may rise. Therefore, the descriptive findings of this study may offer valuable recommendations to the financial industry and decision-makers. This would aid in incorporating AI into businesses and formulating action plans to safeguard data privacy and security in the context of AI-driven banking and consumer behavior (Husain, 2022, p.146).

Despite the growing relevance of AI in the banking industry, there are still few well-defined frameworks that show how AI technologies, specifically machine learning, natural language processing, and predictive analytics, may be methodically incorporated into risk management systems. The lack of knowledge about how sophisticated AI models can surpass conventional risk assessment techniques in actual banking settings while resolving concerns about transparency, ethical compliance, and regulatory alignment is the scientific challenge this study attempts to solve.

The object of this research is the integration of artificial intelligence technologies into the risk management processes of banking institutions. AI's development as a revolutionary tool in a number of sectors, including finance:

Due to its capacity to provide highly automated and data-driven decision-making, AI is rapidly transforming the financial sector.

Literature review

Successful risk management is essential to banks' stability and financial success. It supports investor confidence, regulatory compliance, and asset protection. Inadequate risk management can lead to significant financial losses, penalties, and reputational damage. Integrating AI could enhance the accuracy, efficacy, and predictive capacity of risk management processes. Additionally, AI risk management can enhance an organization's overall decision-making process. Organizations can comprehensively know their risks by combining qualitative and quantitative evaluations, including statistical techniques and professional judgments (Lyeonov, 2024, p.326).

The authors of this work aims to comprehend how AI-based predictive financial modelling contributes to risk management, as demonstrated by market volatility, fraud identification, credit risk profiling, and compliance with established regulatory requirements. Through the implementation of artificial intelligence features, banking institutions can develop real-time risk models. AI also allows risk managers to focus on the high-level duties required to increase the risk resilience of financial organisations by assigning many of the manual chores. Additionally, the AI's ability to learn from massive data sources and analyse all types of sources is crucial since it improves risk prognosis reliability, removes human bias, and produces more accurate forecasts. Concerns including data privacy, the interpretability of AI models, and the issue of the legal frameworks controlling AI in banking are also covered in the study. According to the findings, AI has the ability to fundamentally alter ways the banking sector manages the risks required to operate in the current environment. AI has certain drawbacks despite its benefits in risk management and predictive financial modelling. Therefore, it is reasonable to list the following challenges: intelligibility, accessibility, and feasibility continue to be crucial difficulties, particularly in light of the so-called «black box» dilemma. Financial institutions and regulators also want us to provide an explanation for our decisions, particularly when it comes to credit risk identification and control or loan sanction. Privacy and data security remain major concerns (Vaithilingam, 2022). Because many AI systems work with large data sets, whose dependability is critical for sensitive financial data, it is necessary to focus on the secrecy issue. Concerns about data include how it is gathered, whether it is retained, and how it is utilised, particularly in light of the growing laws pertaining to data privacy. Fourthly, the integration of AI into the existing banking systems indicates that they must make investments in sufficient staff and infrastructure. Banks must either develop AI training internally or rely on outside AI service providers, such as fintech firms. Even so, there is a lot of hope for the future of AI in banking over the next five years, including increased regulatory compliance, model openness, and the broad use of AI-driven risk management (Mhlanga, 2021, p.39).

Overview of traditional risk management methods in banking:

Traditional banking risk management techniques are focus primarily on using established processes like loan underwriting rules to identify, assess, and mitigate specific, well-defined risks like credit risk, operational risk, and management risk (Belanche, 2019, p.1412). This is in contrast to current Enterprise Risk Management (ERM), which aims to control interrelated risks across the bank.

These methods are often compartmentalized, with different departments managing their own risks rather than taking a holistic view across the entire organization. A bank's trading activities are the primary source of market risk, whereas operational risk is the possibility of suffering losses due to internal system malfunctions or outside circumstances. Most big banks compute economic capital in addition to regulatory capital, which is determined by the bank's models rather than by regulators' recommendations (Nnaomah, 2024). In addition to liquidity, business, and reputational risks, banks are primarily exposed to credit, market, and operational risks. Banks actively participate in risk management to monitor, control, and quantify these risks (Hair, 2019,p.3).

Recent advances in AI techniques connected to risk management: Machine learning (ML), natural language processing (NLP), and predictive analytics are examples of recent advancements in Ai techniques which have rendered it possible for banks to detect potential hazards early.

Enhance your evaluation of complicated sets of data and take proactive steps to reduce risks. This is particularly significant to tracking market volatility, detecting fraud, and evaluating credit risk. Financial institutions that provide insurance services for various types of risk incur an important portion of the financial risks. For these businesses, it is vital to ac-

curately estimate the exposure and take the necessary steps to lower these risks. For insurance, there are many different sources of financial risk, and each one demands reliable forecasting models. Considering the development of AI-driven optimization techniques, there are now more chances to enhance risk management.

Neural networks and SVM are two examples of machine learning algorithms that provide the capacity to examine enormous datasets and spot intricate patterns that conventional models could overlook. Banks can gain insights from unstructured data sources like news articles and social media using natural language processing or NLP. Reinforcement learning offers adaptive models that can gain knowledge from experience and gradually enhance risk management techniques. The potential of these methods to increase operational effectiveness and forecast accuracy is shown by research on AI-driven optimization in risk management. Studies have shown that machine learning models can perform better than conventional risk assessment techniques in several applications, such as credit scoring, fraud detection, and market risk prediction. However, data quality, model interpretability, and regulatory compliance challenges must also be addressed (El Hajj, & Hammoud, 2023, p. 434).

Exploration of AI applications in banking beyond risk management, such as loan underwriting, customer segmentation, and investment strategies:

Applications of AI in banking go beyond risk management. These include loan underwriting, where AI can analyze large data sets to make more accurate credit decisions; customer segmentation, which uses AI to classify customers based on their behaviors and needs for personalized offerings; and investment strategies, which use AI-powered roboadvisors to manage portfolios based on individual risk profiles as well as financial goals; fraud detection, chatbot-based personalized customer service, market trend analysis, and compliance monitoring. AI and ML have become essential weapons in the fight against financial crimes, including cybercrime and money laundering. Anti-money laundering (AML) procedures are given top priority by financial organizations to abide by laws and stop illegal activity (Ahmed, 2023, p. 13873). AI and ML methods increase efficiency and reduce manual involvement by automating the detection of questionable transactions. Additionally, by identifying trends in consumer behavior suggestive of fraudulent activities, these technologies make it possible to take preventative action. With the help of computer algorithms, algorithmic trading has become increasingly popular. In high-frequency trading, it is especially common. AI and ML are essential to creating complex algorithms that can analyze massive datasets and find patterns that are beyond human comprehension. This development reduces risk and improves trading performance.

The work focused on using AI and ML applications in financial management (Bouchetara, 2024, p.125). Their analysis, which looked at 283 scientific papers, highlighted how widely machine learning techniques are used. They mainly focused on asset pricing, fintech, and financial fraud in their proposed scope for further study. Nevertheless, they investigated access, financial technology, and financial services with a focus on fintech (Srivastava, 2024). These papers offer useful insights into the literature on fintech. They are not going to offer recommendations for BFSI research, though, and they don't cover every publication.

To frame the study conceptually, this research draws upon key theoretical approaches such as Enterprise Risk Management (ERM), which emphasizes integrated, organization-wide risk governance, and the information Processing Theory(IPT), which explains how AI enhances decision-making by increasing a system's capacity to process complex and large-scale information. These models help contextualize AI's value proposition in overcoming the limitations of traditional rule-based banking systems that are constraint by cognitive and structural rigidity.

The reviewed literature collectively supports the adoption of machine learning algorithms, such as Random Forest, XGBoost, and Gradient Boosting, in risk management processes, due to their superior performance in classification and prediction tasks.

The selection of mixed-method approach, including empirical modelling using Kaggle datasets and a regional survey of bank employees, reflects the need to both quantify model performance and capture institutional perceptions-bridging the gap between theoretical application and practical adoption. This alignment between theory and methodology enhances the academic robustness of the research and validates the relevance of the proposed AI-based framework.

Gaps in existing research

Most respondents predicted that AI and ML would have a positive effect on finance, frequently pointing to increased efficiency and accuracy. This is consistent with previous studies that highlight how AI and ML could transform financial services

by streamlining processes, reducing expenses, and enhancing overall company performance. As professionals and firms attempt to use these techniques to obtain a competitive edge, these advantages may promote the growth and development of AI and ML applications in the financial sector (Rolando, 2024b,p.250). Participants expressed concerns about possible job losses and ethical and privacy issues brought on by AI and ML, notwithstanding this upbeat viewpoint. Task automation-related job loss is a common worry in AI and ML discussions, suggesting possible labor redundancies in various industries, including finance. Job loss is still a contentious topic among policymakers, practitioners, and academics, even though study participants did not view it as an imminent threat. When using AI and ML, significant consideration should be given to ethical and privacy issues, including bias in decision-making or unauthorized data access. Establishing appropriate laws and industry standards is essential to addressing these issues and guaranteeing the ethical and responsible application of AI and ML (Zhang, 2020,p.18).

The complexity of financial risk situations and the technical prowess of ensemble machine learning algorithms like XGBoost, Random Forest, and Gradient Boosting make them applicable in the banking sector. While helpful, traditional statistical techniques frequently struggle to handle data with high dimensions, unstructured information, and non-linear interactions- all of which are common in banking datasets used for compliance monitoring, fraud detection, and credit scoring. The ensemble learning techniques Random Forest and XGBoost are renowned for their excellent accuracy resistance to overfitting and ability to handle missing values. These qualities are vital when dealing with the frequently imbalanced or incomplete real-world banking data. In particular XGBoost learns complex trends and dependencies in the data by applying gradient boosting to decision trees. This ability is crucial for detecting subtle fraud trends and hidden risk indicators that linear models can miss. In the highly regulated banking sector where choices are frequently required to be explicable to auditors and compliance authorities, these algorithms also rank aspects based on their value, which enhances transparency and interpretability. Moreover, they are computationally efficient and scalable, which makes them appropriate for large-scale financial systems where automated decision-making and real-time risk assessment are becoming more and more crucial.

The employment of ensemble methods is theoretically supported by the bias-variance trade-off in machine learning. While boosting algorithms like XGBoost reduce bias by progressively correcting errors, techniques like Random Forest reduce variance by aggregating multiple trees. Because of this, they are highly suited for generalizability and prediction accuracy, especially in high-stakes financial settings where false positives and false negatives can result in substantial expenses.

Finally, empirical studies (e.g., Gautam 2023; El Hajj&Hammoud, 2023) have consistently demonstrated the superior performance of ensemble models in banking-related tasks. These results are consistent with theoretical frameworks from computational finance and decision science that highlight the value of high-dimensional, adaptive, and nonlinear analysis in contemporary risk management.

Methodology

The research goal of assessing how well AI-based solutions, in particular machine learning models, manage banking risks informs the study's methodological design. To achieve this, a mixed-method strategy was adopted that incorporates both descriptive and explanatory components.

The descriptive part of the study uses structured survey data from 200 bank employees in the Middle East to capture institutional perceptions, practical implementation status, and perceived barriers to AI adoption. This provides context and baseline insights into existing risk management practices and digital readiness.

The explanatory component involves technical evaluation of AI models using a real-world dataset from Kaggle, which allows for a controlled assessment of model accuracy, precision, recall, and F1 score. These metrics were selected due to their relevance in classification tasks central to credit risk and fraud detection-key focus areas of this research.

Specifically, models such as Random Forest, XGBoost, and AdaBoost were chosen based on their proven effectiveness in prior financial studies and their robustness in handling imbalanced datasets. The choice of this models is supported by their ability to detect complex non-linear relationships in multidimensional data, which traditional linear models fail to capture.

The research questions guiding this study include:

- How can machine learning models improve prediction accuracy in banking risk assessment?

- Which AI algorithms perform best in detecting credit risk and fraud using real data?

- What institutional and technical challenges hinder AI adoption in banking?

These questions directly informed the dual selection of survey and model analysis tools, ensuring methodological consistency and alignment with the study's overarching objectives.

Systematic fusion in risk management involves combining AI with traditional risk management techniques to improve risk assessment and decision-making. An AI-centered approach considering conventional risk management strategies will produce a more thorough and precise system. AI's ability to circumvent the drawbacks of conventional methods makes it a valuable addition to traditional risk management methods. Traditional risk management methods are synonymous with laborious, expensive, flawed physical labor and subjective judgments. Big data can be quickly and accurately interpreted by AI, which also offers data-based methodologies and a predictive strategy that differs from earlier techniques. Financial institutions will thus have a more exact and accurate method of risk detection, assessment, and mitigation thanks to this collaborative approach. The following steps make up a framework for combining AI augmentation with current risk management techniques (Table 1).

Table 1 – Steps of AI augmentation with current risk management techniques

Step	Description
Data Preparation and Collection	Financial institutions gather data from various sources like market research, internal audits, customer feedback, and regulatory changes.
AI Model Development	Machine-learning algorithms help financial organizations detect patterns, anomalies, correlations, and causal relationships in data.
Model Validation and Testing	AI techniques are assessed using evaluation metrics like F1 score, accuracy, precision, and recall.
Model Deployment and Monitoring	AI models are implemented in real-world scenarios, with continuous monitoring to ensure functionality.
Continuous Improvement	AI systems are regularly evaluated, updated with new data, and integrated with traditional approaches to enhance risk management, improve reporting, and protect data privacy.
Note – compiled by the authors based on the sources (Dewasiri, 2024, p.197)	

Notably, synergy involves combining AI with other conventional risk management techniques to generate a more thorough risk assessment and decision-making process. Financial organizations can apply an AI combination of current risk management methodologies to achieve accuracy and consistency in risk detection, assessment, and management. The research problem can be resolved more easily when an appropriate research approach is chosen for the investigation. Since this study is mostly quantitative, it used both descriptive and explanatory methodologies, which facilitate information gathering. Quantifiable data are used to better comprehend how different research variables affect to one another. A descriptive research methodology was selected for examining respondents demographic distribution and general opinions about the issue. This study used an innovative research technique which combined both deductive and inductive methods. The research approach enhances the study's credibility and serves as a guide for carrying out the investigation. A hybrid method was chosen to enhance the accuracy of research findings. The survey utilized to gather primary quantitative data from the respondents served as the foundation for the research strategy for this study. The survey approach was chosen to collect data from a big sample population – 200 bank employees from certain banks in the Middle East and a wide geographic area. A structured, closed-ended questionnaire was the research tool utilized in this study to gather quantitative data. They were contacted and polled to find out where AI is being used and how it affects the Middle Eastern banking industry's performance (Zhan, 2024, p.190).

Data Analysis:

The study is based on a secondary dataset from Kaggle. This dataset contains actual bank statistics provided on the internet after clients' sensitive personal information has been removed. There are two separate data files: application_record.csv and

credit_record.csv. The first application record dataset contains the applicants' information, which can be used as predictive features. The second dataset, credit record, monitors consumers' credit card usage patterns (credit history). ID column (primary key) connects application and credit record datasets. The data was created by combining two tables linked by ID. The credit_record.csv file has three columns: client ID, record month, and customer status. To begin, record the month in which the data was collected. Moving backward, 0 indicates the current month, and -1 represents the previous month. The status column shows the following amounts as past due: 0: 1-29 days, 1: 30-59 days, 2: 60-89 days, 3: 90-119 days, 4: 120-149 days, and 5: write-offs for past-due or bad debts lasting more than 150 days. «C» denotes the month's payments, whereas «X» signifies no loan for the month.

Exploratory Data Analysis (EDA)

Raw data, often known as unprocessed data, is only helpful if there is something to learn from analyzing it. EDA entails analyzing and visually portraying data to acquire insights and summarising key data features to understand a dataset better.

According to IBM, EDA provides customers with a deeper understanding of variables in data collection and their relationships. It is typically used to investigate what data can be disclosed beyond the formal modeling or hypothesis testing assignments. EDA can also help determine whether the statistical procedures under consideration for the study methodology are adequate.

Some methods include many features, which can make layout and training processes more time-consuming and memory-intensive. Each feature must devote a significant amount of time and effort to scanning through the numerous data instances and estimating every potential split point, which is the fundamental cause of this behaviour. Fewer attributes are recommended to save time during the computing process and improve method performance. Table 2's summary statistics help better understand the variable distribution.

Results and discussions

When determining a borrower's credit score, credit scoring algorithms usually consider several variables, such as the borrower's history of on-time payments on prior obligations. The difference between the borrower's available credit limits and the amount of credit they have used. The duration of the borrower's credit usage. Variety of credit accounts, including mortgages, loans, and credit cards. how many people have recently checked a borrower's credit record? Lenders use various credit scoring methods to assess borrowers' creditworthiness for various credit applications. These models are customized for particular sectors, like mortgage or auto loans. Several lenders use specialized scoring models Depending on their lending requirements and risk tolerance. A company's financial performance and creditworthiness are calculated utilizing financial ratios, which are quantitative measurements from its financial statements. Financial measures like the debt-to-equity ratio and the debt service coverage ratio, which gauge a company's leverage and capacity to pay off its debts, are frequently employed in credit risk assessments. such as return on equity and return on assets, which show how profitable and effective the business produces returns, such as fast and current ratios, which calculate a business's capacity to pay short-term debts. The association between borrower attributes and credit risk is modeled using statistical methods like logistic regression and discriminant analysis. By examining past data, these methods find trends and connections that can be utilized to forecast the probability of default.

The console prints the results of the method calculation, including accuracy, F1 score, precision, recall, and confusion matrix, which provide useful insights into the effectiveness of the chosen ML method for loan approval prediction.

The base measure utilized for method calculations is frequently accuracy, which describes the number of correct predictions out of all forecasts:

$$\text{Accuracy}=TN+TPTN+FP+FN+TP \quad (1)$$

Next statistic is accuracy, which evaluates how many positive forecasts are correct (true positives):

$$\text{Precision}= TPTP+FP \quad (2)$$

Recall is a measure of how many positive cases the classifier properly predicts out of all positive examples in the data.

$$\text{Recall}= TPTP+FN \quad (3)$$

F1 score is a measure that combines precision and recall. It is commonly known as the harmonic mean of two:

$$\text{F1 Score}=2 * \text{Precision} * \text{RecallPrecision}+\text{Recall} \quad (4)$$

Table 2 – Summary statistics of variables

Indicator	Count	Mean	Std.Dev	Min	25 %	50 %	75%	max
ID (Unique Identifier)	438557.000	6022176270	571637.023	$008804.000	$609975.000	6047745.000	6456971.000	7900062000
Number of Children	438557.000	0.427	0.725	0.000	0.000	0.000	1.000	10.000
Total Annual Income(KZT)	438557.000	187524.286	5 110066.853	26100.000	121500.000	160780.500	225000.000	6750000.000
Application Height(mm or score unit)	438557.000	+15007.905	4185.000	25201.000	19483.000	15630,000	12514.000	.7499.000
Applicant Weight (possibly income gap)	438557.000	60563.675	138767.800	17631.000	3103000	1467.000	.371.000	365243000
Marital status indicator (binary)	436567.000	51.000	0.000	-1.000	-1.000	- 1.000	1.000	1.000
Job status Indicator(employed/ unemployed)	439557.000	0206	0.405	0.000	0000	0.000	0.000	1,000
Home Ownership Indicator	438557.000	0.288	0.453	0.000	0.000	0.000	1,000	1.000
Education Level Indicator	438557.000	0.108	0.311	0.000	0.000	0.000	0.000	1.000
Number of Family Members	438557.000	2.194	0.897	1.000	2000	2000	3.000	20.000
Note – compiled by the authors based on the source (Naeem, 2025:84-91)								

Confusion matrix visualization enabled a thorough examination of method classification accuracy and error rates. Algorithms were implemented in Python, and data processing was performed using well-known libraries such as Pandas, Numpy, and Sklearn. After loading the dataset, preprocessing was done to improve method efficacy, resulting in better results.

Additionally, computing resources should be considered, mainly when dealing with massive datasets. Some methods are computationally expensive. Therefore, their performance must be weighed against available resources. Analysis results should be interpreted with caution.

Multiple metrics generated from a confusion matrix are commonly used to measure the efficacy of a classification model. The confusion matrix summarises method performance by displaying four main metrics: true negatives (TNs), false positives (FPs), false negatives (FNs), and true positives (TPs).

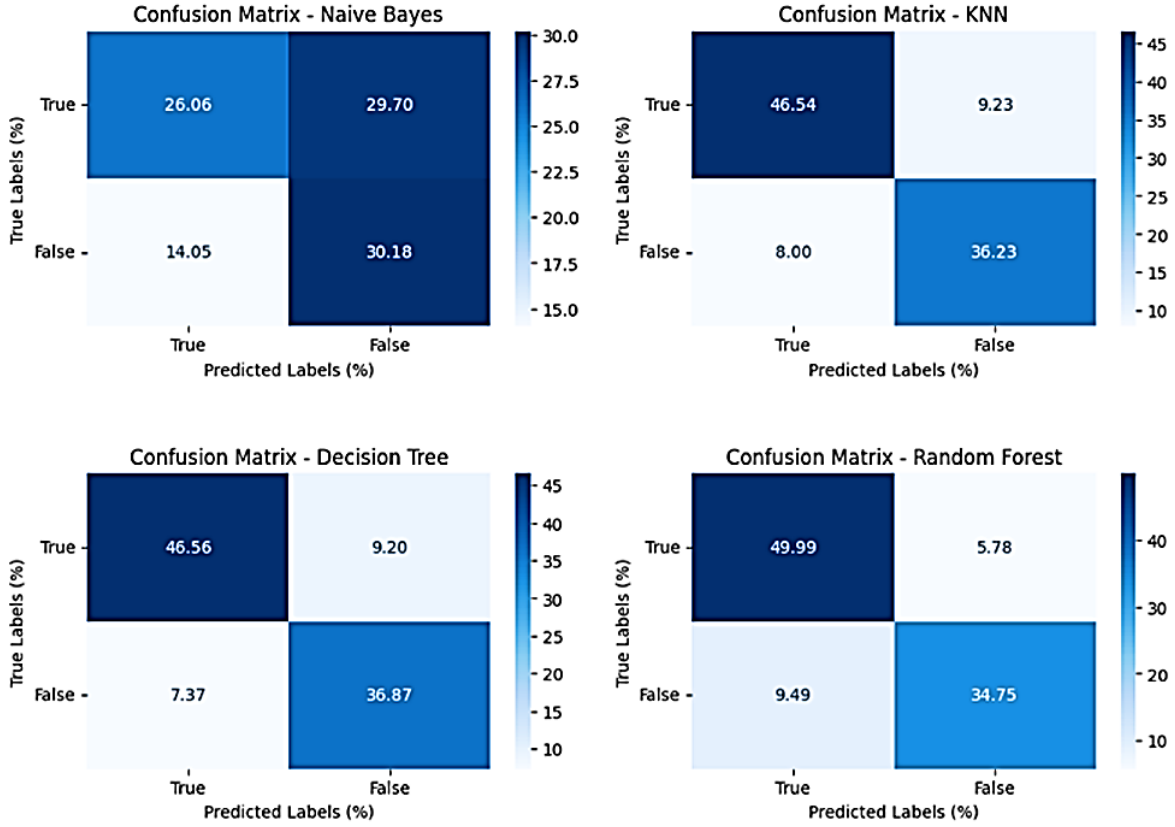

Figure 1 – Confusion matrix
Note – compiled by authors based on the source (Henseler, 2010:714-725)

Table 3 and Figure 1 show the findings of our analysis using the confusion matrix. The binary classification issue distinguishes between regular observations and observations with a specific outcome as shown in figure 1. According to our model's projections, the clients will either default on their debt or not.

This results in the following:

True positives occur when good consumers are correctly expected to be good customers.

False positive – when poor consumers are mistakenly identified as good ones.

True negative – when bad consumers are correctly expected to be bad clients.

False negative – when friendly consumers are mistakenly identified as bad customers.

The equations for calculating the respective rates are as follows:

Actual positive = Number of clients correctly projected as excellent / Actual number of good consumers

False positive = number of clients incorrectly projected as good/actual number of negative customers.

True negative = Number of clients correctly predicted as bad / Actual number of bad customers

False negative = number of consumers incorrectly forecasted as poor / actual number of excellent customers.

Test samples show that 7422 are excellent clients and 7406 are bad ones. Based on the number of real good and terrible clients for the prediction algorithm, we will compare FPR, TPR, FNR, and TNR for the best and worst-performing methods.

Table 3 – Confusion matrix results

	True Neg	False Pos	False Neg	True Pos
Naive Bayes	15.48%	78.17%	1.59%	4.76%
Random forest	1.59%	1.59%	15.48%	81.35%
Decision tree	3.97%	11.90%	13.10%	71.03%
KNN	1.19%	3.97%	15.87%	78.97%
AdaBoost	2.38%	4.37%	14.68%	78.57%
XGBoost	1.98%	1.19%	15.08%	81.75%
Gradient boost	3.17%	3.17%	13.89%	79.76%
Note – compiled by authors based on the source (Truby, 2022:272)				

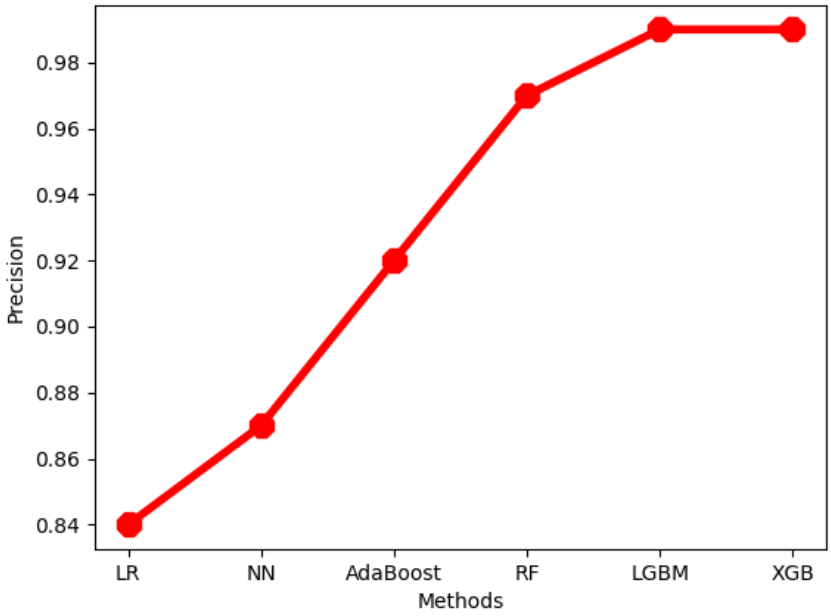

Figure 2 – Precision comparison
Note – compiled by authors based on the source (Waltman, 2019)

According to the accuracy and recall comparison bar charts in Figures 2 and 3, the model XGB has the best possible precision and recall (both 0.994), followed by the model LGBM (0.992 and 0.993). Furthermore, logistic regression has the lowest precision and recall scores (0.846 and 0.843, respectively).

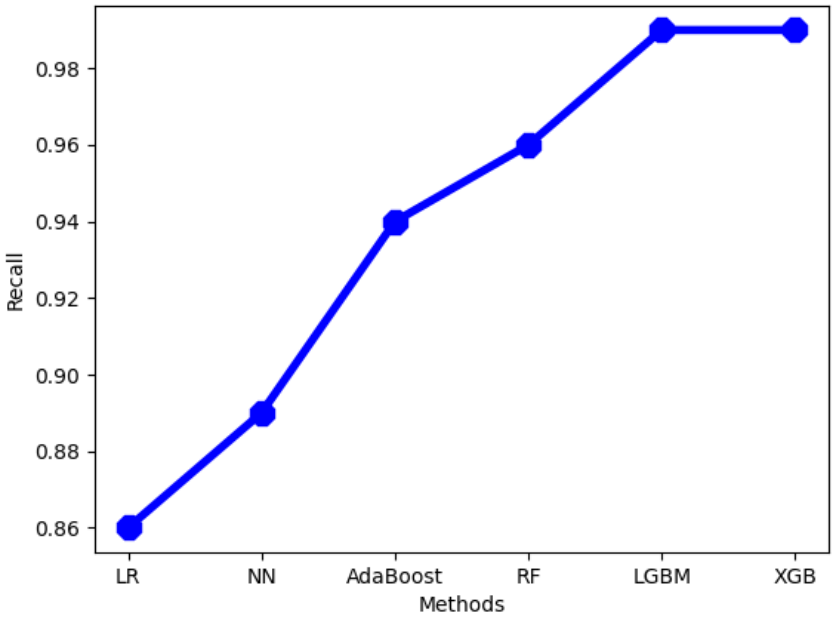

Figure 3 – Recall comparison
Note – compiled by authors based on the source (Waltman, 2019)

F1 Score

The F1 score represents a harmonic recall and precision average ranging from 0 to 1. For a binary classification task, optimizing for the F1 score is the most recommended quality metric. The overall performance of the method improves as the F1 score rises, with 0 being the lowest and 1 being the highest. Only when precision and recall are 100% can the F1 score reach its optimal level of 1. If one of these equals 0, the F1 score's worst value is zero.

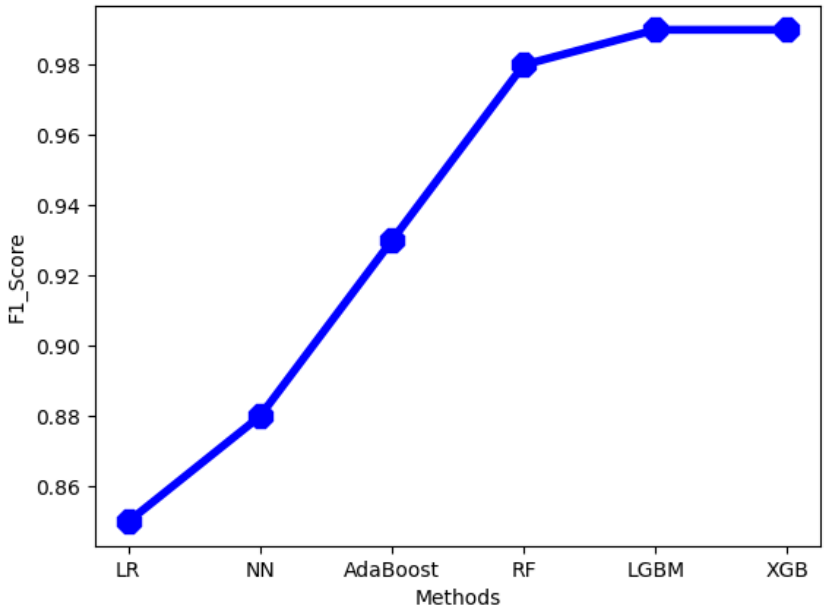

Figure 4 – F1 score
Note – compiled by authors based on the source (Vaithilingam, 2022)

Figure 4 reflects the scenario in the same way recall and precision were explained earlier. This shows that method XGB earns the best possible F1 score because it has the maximum recall and precision. Methods closer to the top left corner, corresponding to Cartesian plane coordinate (0, 1), perform better than those listed below.

The test will become less exact as the graph approaches the ROC plot's 45-degree diagonal. One of the many reasons the ROC curve is so useful is that it is independent of the class distribution. It permits and facilitates circumstances in which classifiers forecast odd events, corresponding to our interest in detecting undesirable consumers.

AUC values vary from zero to one. An AUC of 0 suggests a model with 100% erroneous predictions, whereas an AUC of 1 represents a method with all correct predictions. If the area under the curve (AUC) equals 0.5, we can deduce that the method is incapable of distinguishing between good as well as bad consumers properly.

On a ROC curve, a higher value on the x-axis indicates more false positives than true negatives. At the same time, a higher number on the y-axis indicates a greater proportion of TP vs FN. As a result, threshold selection depends on the ability to balance FP and FN. A comparison of random forest, neural networks, XGB, LGBM, AdaBoost, and logistic regression models is shown below. Figure 5 indicates that XGB and LGBM perform better.

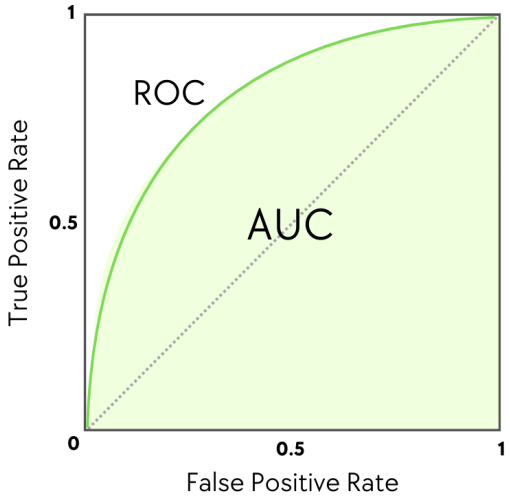

Figure 5 – ROC–AUC curve
Note – compiled by authors based on the source (Yao, 2023: 2777)

Economic Implications of Machine Learning in Credit Risk Assessment

Machine learning has altered credit risk assessment in the banking and finance industries by providing a data-driven method to evaluating borrower's creditworthiness. ML has significant fiscal consequences for the banking sector as well as to its technical promise. These include improved regulatory compliance and risk management, increased accuracy and predictive power, cost reductions, and efficiency gains.

This explores economic monetary effects by looking at how machine learning alters credit risk assessment processes and supports institutions stability and financial well-being. Increasingly accurate risk assessments are rendered practical by spotting little features and relationships that human researchers and traditional credit risk models night overlook. This tailored method improves the level of detail and accuracy of credit risk evaluations correctly matching loan terms and price to borrower's risk profiles, maximizing risk-adjusted earnings and minimizing credit losses.

In credit risk assessment, fraud detection and prevention involves employing advanced data analytics and monitoring technologies to spot suspicious trends and activities in credit transactions or loan applications. This aims to reduce financial losses for lenders and actively stop fraudulent activity before a loan is granted. Putting a system in place to

recognize and evaluate possible risks and stop illicit transactions before they are completed is the most efficient way to avoid fraud. Numerous risk management technologies, including transaction pattern analysis and advanced data analytics, should be integrated in a thorough fraud detection system.

Detecting financial fraud is a set of methods and procedures designed to reduce risk. Scammers frequently target financial institutions because they may transfer money and have instant access. Bank fraud issues can be broadly categorized into three categories:

Customer Onboarding

Regulations like KYC (know your customer) and AML (anti-money laundering) make digital onboarding, a component of customer acquisition, problematic for banks. Using customer risk assessment, these regulatory criteria verify user identities and ensure they won't commit financial crimes. Scammers use phony or synthetic identification documents to trick the system and open bank accounts. In 2020, the cost of ID verification is expected to reach $35.2 billion. It's particularly challenging for challenger banks and neobanks, which must quickly and effortlessly attract new clients.

Credit card prevention

To successfully avoid credit card fraud, issuing organizations should be informed of any unusual transactions or withdrawals. Because they only have access to the merchant's name, category, amount, and currency, it is difficult to spot trends. If they try to use these criteria to block fraudulent payments, they run the danger of creating high false positive rates, which would irritate responsible cardholders. Other regulatory criteria involve validating the legitimacy of the financing source and using Strong customer Authentication (SCA).

Account protection

An account takeover (ATO) takes place when hackers manage to get their hands on an actual user's login credentials. They use the account as their own, which has a terrible impact on bank's connections with their customers. In addition to allowing other types of fraud and criminal conduct. Banks must therefore take every safety measure to protect the accounts of their clients.

Naturally, the larger issue is that fraud is adaptive. In other words, when their activities are restricted, scammers will swiftly realize and try a different strategy. Solutions like AML software and KYC technologies must be effective and adaptable.

Regulatory compliance and reporting

Financial institutions' risk management teams invest significant time and money in obtaining and tracking data about various risk factors, including transaction restrictions, exposure limitations, regulatory constraints, and so forth. Furthermore, risk reporting has become a strategic function due to the constantly changing regulatory standards and increased management attention to risk management. Even while technology is essential to running these activities, having a sizable staff of risk analysts committed to ad hoc reporting and routine risk monitoring has become essential (Umamaheswari, 2023, pp. 2841-2849).

In the banking industry, artificial intelligence (AI) is being used to reduce a growing number of risks, such as credit and market risks, transaction risks, model risks, cybersecurity risks, infection risks, and compliance risks (Table 4).

Table 4 – Risks in the banking sector

Risk type	Description
Credit risk	The possible loss that results from loan default by counterparties or borrowers.
Market risk	Financial markets' volatility poses a serious threat to banks' bottom lines. AI techniques like machine learning, deep learning, and natural language processing are used to forecast trends and enhance decision-making.
Operational risk	Includes losses due to system breaches, service interruptions, or failures in internal systems and processes.
Model risk	Banks rely on various models to forecast and plan their operations, but flaws in these models can introduce risks.
Cybersecurity risk	The growing number of attack vectors in an interconnected world poses cybersecurity threats. AI-driven machine learning and deep learning detect anomalies, predict attacker behavior, and mitigate risks.
Contagion risk	Economic disruptions, such as the global impact of COVID-19 or financial collapses in foreign markets, can affect banking operations and existing loan arrangements.
Compliance risk	If banks fail to comply with regulations, they may face financial loss, legal consequences, or reputational damage. Regulatory compliance is an ongoing and complex challenge.
Note – compiled by the authors based on the sources (Ahmed, 2023).	

AI significantly affects contemporary sectors like manufacturing, retail, healthcare, and finance. Repetitive operations could be replaced, vast amounts of data could be analyzed to gain insights, processes could be optimized, decision-making could be enhanced, and adopted consumer experiences could be provided. Ultimately, this results in improved creativity and operational efficiency.

Conclusion

By improving the precision and effectiveness of several procedures, including fraud detection and credit risk assessment, machine learning (ML) has profoundly transformed the banking sector.

The application of AI and ML in the banking industry has attracted a lot of attention in recent years. The objective of this paper is to present a thorough evaluation of the corpus of research on the application of AI-based risk management in the banking sector. This study used a desk methodological approach to compile the development and use of AI in financial risk management.

This investigation is unique because it integrates qualitative survey data from a geographically specific banking population (the Middle East) with real-world banking datasets and sophisticated machine learning techniques. In contrast to previous research, which frequently concentrates only on theoretical models or regionally isolated applications, this work uses ensemble models and evaluates comparative performance using confusion matrices, ROC curves, and F1 scores.

The suggested method has a lot of potential for use in Kazakhstan and other CIS nations, where banking systems are rapidly moving digital but still have issues with legacy infrastructure and regulatory adaption. Local banks can improve their credit scoring processes by using XGBoost and Random Forest models, especially in high-risk or underserved borrower sectors where traditional scoring models and imprecise. Additionally, incorporating AI into fraud detection systems can provide real-time transaction monitoring, which is crucial for reducing the region's growing cyberthreats.

The suggested AI framework could be used practically by Kazakhstani commercial banks to enhance compliance reporting through automated anomaly detection, decrease false positives in anti-money laundering (AML) systems, and streamline loan approval processes in online banking platforms. In addition to improving operational effectiveness, these applications would boost regulator and customer trust.

Despite its advantages, using machine learning in the financial sector comes with a number of risks and challenges. Sensitive data is essential in the financial sector. Because financial institutions handle vast amounts of transactional and personal data, data security and privacy are essential. Serious consequences, including financial loss, penalties, and reputational damage, can result from data security breaches. Financial data sometimes contains very sensitive information, such as personal identification numbers, transaction histories, and bank account numbers. Preventing unwanted access to this data is one of the main obstacles. Removing personally identifiable information (PII) from datasets can lessen privacy risks while allowing data analysis. In the financial sector, it is crucial to comprehend and explain ML model decisions.

As the banking industry develops further, artificial intelligence's contribution to risk management will be crucial to maintaining stability and growth in a setting that is becoming more and more competitive. In the banking industry, risk management is a crucial field that encompasses a variety of procedures meant to detect, assess, an lessen possible unforeseen circumstances that can have a detrimental impact on the institution's operational stability and financial health.

The paper's key findings and observations demonstrate how AI optimization and methodology could be revolutionary components of banking risk management systems in the future. Banks may use AI algorithms to access the most comprehensive data sources, perform risk assessments, fraud detection, predictive analytics, real-time monitoring and warnings, and make the right decisions. AI can improve the accuracy, speed, and efficiency of risk management, which will ultimately lead to a more successful risk management strategy. Executing the plans of increasingly digital bank institutions requires a shift from analog to risk management. Making the most of blockchain technology and artificial intelligence is one of the most important phases in this process.

In turn, artificial intelligence makes it possible to process massive amounts of unstructured data risk, create appropriate models for evaluating market risk, fully automate manual processes in the function, more precisely identify future issues, and computerize credit scoring. AI risk management aids banks in better understanding and reducing risk. Banks may swiftly uncover insights that help

them halt losses and increase their customer's return on investment by analyzing large amounts of data thanks to artificial intelligence (AI). AI is being used in the banking sector to counter a growing variety of dangers.

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FLYING GREEN: MEDIA'S POWER IN TRANSFORMING AIR TRAVEL AND TOURISM SUSTAINABILITY NARRATIVES IN BRICS+ NATIONS

This study explores the transformative role of media narratives and smart technologies in fostering sustainable air travel and tourism within BRICS+ countries. As environmental degradation accelerates and public awareness rises, media platforms are becoming critical instruments for shaping sustainability discourses, consumer behavior, and policy frameworks. The study applies a secondary data analysis approach, utilizing a curated dataset of 106 journal articles, policy documents, social media content, and tourism industry reports spanning the years 2015 to 2024. The research employs content analysis, thematic analysis, and the Sustainability Narrative Analysis Tool (SNAT), underpinned by Media Framing Theory. Key findings demonstrate that media narratives significantly influence consumer decision-making, industry adaptation, and the adoption of smart technologies like VR, AI, and IoT to support sustainable tourism. Nevertheless, challenges such as greenwashing and digital divides hinder full realization of media's transformative potential. A conceptual model is developed to illustrate the interplay between media discourse, technology adoption, and sustainable tourism outcomes. This study provides policymakers with evidence-based recommendations for designing inclusive sustainability regulations, offers guidance for industry stakeholders in implementing ethical green marketing, and encourages media professionals to adopt responsible storytelling. The paper contributes an original conceptual framework bridging digital communication and sustainable tourism governance within the emerging economies of the BRICS+ alliance.

Keywords: sustainable tourism, media framing, smart technology, BRICS+ Nations, climate governance.

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Жасыл әуе сапарлары: BRICS+ елдеріндегі әуе көлігі мен туризмнің тұрақтылығы туралы баяндауларды өзгертудегі медианың рөлі

Бұл зерттеу мына сұраққа жауап іздейді: BRICS+ елдерінде медиа тұрақты туризм мен әуе сапарлары дискурсына қалай ықпал етті? Туризмнің қоршаған ортаға әсері мен тұрақты маркетингтің қажеттілігі артып келе жатқан қазіргі кезеңде бұл жұмыс туризм мен тұрақтылық арасындағы алшақтықты толтыруды көздейді. Зерттеу медиа мен технологиялардың тұтынушыларға, салаларға және саясатқа әсерін талдап, тұрақты тұтыну мен өндіріске әкелетін үлгілерді анықтайды. Зерттеу әдістемесі ретінде 2015–2024 жылдар аралығындағы ғылыми мақалалар, әлеуметтік желідегі жазбалар, үкіметтік құжаттар мен академиялық еңбектер пайдаланылып, сандық және сапалық деректер негізінде медианың дискурстық құрылымдары сараланды. Мазмұндық және тақырыптық талдаулар арқылы кең таралған медиа фреймдер анықталып, олардың жағымды немесе жағымсыз сипаты бағаланды, сонымен қатар олардың көпшілік пікірін немесе салалық шешімдерге әсер ету деңгейі зерттелді. Ұсынылған үлгі медиа-хабарламалар, смарт-технологияларды пайдалану және тұрақтылық көрсеткіштері арасындағы өзара байланысты сипаттайды. Зерттеу нәтижесінде тұрақты әуе көлігі мен туризмнің әлеуметтік-экологиялық дискурстарын айқындайтын негізгі құрылымдар анықталды. Жасыл өнімдер жайлы баспасөздегі ақпарат тұтынушы қабылдауын қалыптастырып, индустрияның бейімделуіне ықпал етеді. BRICS+ елдері аясындағы қазіргі ынтымақтастық дәстүрлі туризм дискурсын тарихи мұраны сақтау мен қорғауға басымдық бере отырып қайта қарастыруда. Алайда, цифрлық теңсіздік пен «жасыл жуу» секілді мәселелер әлі де өзекті. Ұсынылған ұсыныстар саясаткерлерге тиімді реттеу тетіктерін әзірлеуге, салалық өкілдерге тұрақты стратегияларды іске асыруға, ал медиа мамандарына тұрақтылықты дұрыс баяндауға көмектеседі. Бұл зерттеу медианың экологиялық тұрақтылық пен тұтынушылыққа ықпалын зерделеу үшін бастапқы қадам ретінде қызмет атқарады. Сонымен қатар, BRICS+ елдерінің ерекшеліктерін ескере отырып, смарт

әсері туралы жаңа тұжырымдамалық үлгі ұсынады. Осылайша, бұл еңбек тұрақты туризм жайлы пікірталасты жалғастырып, жаһандық климаттық өзгерістер контекстіндегі медианың рөлін көрсетеді.

Түйін сөздер: жасыл туризм, медиа фрейминг, жаңа медиа, BRICS+ елдері, климаттың өзгеруі.

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Зелёные перелёты: роль медиа в трансформации нарративов устойчивого туризма и авиаперевозок в странах BRICS+

Данное исследование посвящено следующему вопросу: как медиа влияют на дискурсы устойчивого туризма и авиаперевозок в странах BRICS+? По мере того как последствия туризма становятся всё более очевидными, а потребность в устойчивом маркетинге возрастает, данная работа восполняет разрыв между устойчивостью и туризмом. В исследовании анализируются способы, посредством которых медиа и технологии воздействуют на потребителей, индустрию и политику, способствуя формированию моделей устойчивого потребления и производства. Используются как количественные данные вторичного характера, так и качественные данные, полученные с использованием теории фрейминга в медиа. В качестве источников рассматриваются научные статьи, публикации в социальных сетях, правительственные документы и академические работы за период 2015–2024 гг. Содержательный и тематический анализ позволил определить основные медиа-фреймы, оценить их позитивную или негативную направленность, а также степень влияния на общественное мнение и действия заинтересованных сторон. Предлагаемая модель фокусируется на взаимосвязи между медийными сообщениями, использованием смарт-технологий и показателями устойчивости. В результате исследования были выделены основные дискурсивные конструкции, способствующие продвижению экологического и социального аспектов устойчивого авиасообщения и туризма. Восприятие потребителей и адаптация отрасли формируются под влиянием публикаций о «зелёных» продуктах, что ведёт к росту потребления. Современное сотрудничество в рамках BRICS+ переосмысливает традиционные туризм-дискурсы, акцентируя внимание на историческом наследии и охране природы. Вместе с тем сохраняются такие проблемы, как цифровое неравенство и гринвошинг. Представленные рекомендации помогут политикам в разработке эффективных нормативных актов, бизнесу – в реализации устойчивых стратегий, а журналистам – в профессиональном освещении проблем устойчивости. Исследование служит отправной точкой для дальнейшего изучения роли медиа в обеспечении экологической устойчивости и потребительской культуры. Кроме того, разработана новая концептуальная модель, раскрывающая влияние медиа на внедрение смарт-технологий в контексте специфики стран BRICS+. Таким образом, работа продолжает дискуссию об устойчивом туризме и подчёркивает значимость медиа в трансформации глобального климатического сознания.

Ключевые слова: зелёный туризм, фрейминг, новые медиа, страны BRICS+, изменение климата.

Introduction

Aviation and tourism sectors are primary determinants of global economic development and it is worth mentioning that they create a significant share of the gross domestic product and employment rates in numerous countries, including the states within the BRICS+ partnership agreement until 2024 (Seyfi & Hall, 2024). However, the environmental footprint of these industries inclusive of greenhouse gas emissions and loss of ecosystems has become a major global concern. As a result, sustainable tourism has emerged as a way of achieving the objective of creating value for the economy without compromising the earth's environment. Communications media as a tool for changing perception and behavior is central to the dissemination of sustainable practice discourses especially in emergent economy nations in the context of the BRICS+ discussions (Sankar & Ilangovan, 2025).

Many papers have been written on how media and technology support the promotion of sustainable tourism. Sankar and Ilangovan (2025) stress that VR and interactive media improve the sustainability of eco-tourism by using narratives. Seyfi and Hall (2024) outline how the geopolitics of BRICS nations can transform the discursive construction of tourism and argue how they can disrupt Western compliance sustainability frames. In addition, Næss and Hahm (2024) present the work

that shows that media play an essential part in raising public's awareness on sustainable tourism practices, and Masson (2024) question the ability of media to contribute to greenwashing. However, knowledge of the systemic role of media in promoting sustainable tourism practices within the BRICS+ environment and the prospect of integrating smart technologies with sustainable frameworks remains limited.

Prior research revealed the role of media in tourism and sustainability, but it mainly targets developed countries or few country case studies. Consequently, there is a critical gap concerning the integrated impact of media narratives and smart technologies in enabling sustainable tourism in BRICS+ countries. This is a very important gap, especially in view of the socio-economic cultural and environmental contexts in these countries.

Therefore, the purpose of this paper is to examine how media can help change air travel and tourism sustainability discourses in the BRICS+ countries. It examines how new technologies and media shape consumers and business actors' behaviors, industries, and policies to support sustainable tourism.

Background

The study is located at the forefront of social concerns, global sustainable development initiatives, and the ever-evolving media and technology landscape. Due to their varied socio-economic profiles and significant geopolitical importance, BRICS+ nations offer a compelling context for examining these phenomena. While prior research has described the role of media and technology in transforming the tourism sector, no studies have investigated their impact on fostering sustainability in emerging economies. This paper, therefore, addresses this gap by exploring how BRICS+ countries can leverage media and technology to encourage sustainable tourism.

The study's main contribution lies in constructing a novel theoretical framework that links media narratives with smart technology adoption within the unique socio-economic and cultural contexts of BRICS+ countries. Beyond theoretical and practical implications, this paper also offers guidelines for tourism and aviation business actors.

The paper begins with a general introduction that illustrates the topic's relevance, provides a brief literature review, defines the research gap, and outlines the research aim and main contributions. The method section describes the approach employed for secondary data analysis, along with the analytical tools used. The findings section presents an overview of the results regarding media discourses, smart technology use, and sustainable practices. The discussion contextualizes these findings within the broader sustainability discourse, concluding with a summary of implications and directions for future research.

This paper focuses on the intersection of sustainability challenges and growth opportunities for the aviation and tourism industries in BRICS+ countries. While media and smart technologies can significantly encourage sustainable tourism practices, few of these emerging economies have comprehensively explored their impact on consumers, industries, and policies.

Research Objectives

1. To identify the key discursive structures of sustainable air travel and tourism in BRICS+ countries.

2. To analyze how smart technologies can support sustainable tourism experiences.

3. To assess the effect of different media stories on consumer behaviors, business strategies, and policy decisions.

Research Questions

1. How are BRICS+ nations discursively constructing media discourses related to sustainable air travel and tourism?

2. In what manner do intelligent systems play a role in improving sustainable tourism experiences?

3. What do these media narratives do to the behavior of the consumers, the practices and policies of the industries and the policies and laws?

It is important to note that this research has academic implications as well as important practical implications. In general, for policymakers, it provides understanding of what makes sustainability frameworks effective. For industry actors, it gives an approach to how sustainability can be implemented into business processes. To the media practitioners, it raises awareness of effective communication in products, events and information about sustainability. In addition, the study helps to address an important research gap by exploring the concept of sustainable tourism in the context of BRICS+ nations, inclusive of a global outlook.

This study not only identifies dominant narratives in sustainable tourism within BRICS+ but also offers a novel integrated model linking media impact and smart technology with policy and consumer behavior – providing actionable insights for stakeholders.

Literature review

To fully comprehend the role of media and technology in sustainable tourism, this study draws upon insights from various theoretical perspectives and recent literature. For instance, Sankar and Ilangovan (2025) highlight how virtual reality and artificial intelligence contribute significantly to shaping green tourism experiences. Their work also underscores the importance of engaging narratives in developing sustainable tourism, particularly within emerging economic markets. Other scholars supporting these ideas include Seyfi and Hall (2024), who consider the geopolitical importance of BRICS+ nations in this context, and Næss and Hahm (2024), who discuss the media's role in promoting sustainability agendas.

However, other authors, such as Masson (2024), offer a critical perspective, cautioning against the media's potential role in contributing to greenwashing. This critical viewpoint aligns with broader concerns raised by scholars examining sustainability in BRICS+ countries. For instance, Zhang (2024) analyzes the geopolitical considerations of sustainability in these nations, while Magolie (2024) investigates infrastructural investments aimed at addressing poverty and enhancing sustainable tourism, both implicitly and explicitly highlighting the complexities of sustainability communication and implementation.

Conversely, critics like Lee (2024) and Dominguez (2024) argue that media often provides mere 'lip service' to sustainability issues, failing to engage with the complex underlying problems or the comprehensive frameworks designed to address them. This divergence in perspectives highlights the field's complexity and the necessity for an all-encompassing framework that accounts for the variety of positions held by researchers and practitioners.

The theoretical and conceptual frameworks that will be significant in the study are as follows.

This study is underpinned by media framing theory, particularly as it applies to sustainability narratives. Entman (1993) initiated contemporary discussions on framing, defining it as the careful selection and emphasis given to specific aspects of reality, while marginalizing or ignoring others, thereby shaping public perception and decisions. Building on this, scholars like Scheufele and Tewksbury (2007) have expanded on the concept of media framing and its profound influence on public attitudes and behaviors.

In the context of sustainable tourism development, these frameworks allow us to view media as a crucial platform that shapes discussions and, consequently, guides consumer and industry behavior. Media, for instance, acts as a primary source of information regarding the availability of eco-tourism products, best practices in sustainability, and the negative effects of conventional tourism. For example, Seyfi and Hall (2024) contend that media framing activities in BRICS+ countries have been instrumental in advancing ecotourism, rooted in cultural and environmental values for sustainable living. Conversely, Masson (2024) demonstrates how media can promote greenwashing, fostering scepticism among consumers. The way sustainability is presented, therefore, significantly influences stakeholder attitudes toward the transition to sustainable processes. The theoretical foundation of this research integrates insights from communication scholarship, tourism literature, and sustainability science.

Media framing, as defined by Entman (1993), is the process by which certain aspects of reality are made prominent while others are marginalized or ignored, thereby shaping public perception and decisions. In the context of sustainable tourism, the media serves as a crucial source of information regarding eco-tourism products, best practices in sustainability, and the adverse effects of conventional tourism. For example, Seyfi and Hall (2024) contend that media framing activities in BRICS+ countries have been instrumental in advancing ecotourism, rooted in cultural and environmental values for sustainable living. Conversely, Masson (2024) demonstrates how media can inadvertently promote greenwashing, fostering skepticism among consumers. The way sustainability is presented, therefore, significantly influences stakeholder attitudes toward the transition to sustainable practices.

Smart Technology Adoption: Recent technologies such as Virtual Reality (VR), Artificial Intelligence (AI), and the Internet of Things (IoT) are revolutionizing the tourism industry by offering innovative solutions to sustainability challenges. Buhalis and Law (2022) emphasize that applying new technologies in tourism is crucial not only for achieving sustainable outcomes but also for improving operational efficiency and minimizing negative environmental impacts. For instance, Sankar and Ilangovan (2025) argue that VR's immersive capabilities allow for experiences that don't require physical travel to environmentally sensitive areas, thus reducing ecological footprints (Rena,2024).

Similarly, smart IoT in transportation and AI-powered recommendations for eco-friendly travel options, alongside IoT applications in hotels and airlines, enhance efficiency by conserving energy and reducing waste. These technologies also contribute to environmental conservation by making sustainable choices more appealing and engaging for tourists. Ultimately, integrating such technologies is vital for achieving environmental sustainability and economic development goals in BRICS+ countries.

Consumer Behavior: Media and technology are also significant determinants of consumer behavior, particularly in the context of travel. Næss and Hahm (2024) found that increased awareness of air travel's negative environmental effects has prompted media to promote green solutions, such as carbon-neutral flights and sustainable lodging options. Consequently, smart technologies further assist consumers by providing tailored information on their environmental impact. Gössling et al. (2021) highlight how crises, such as the COVID-19 pandemic, amplify the media's importance in shaping consumer attitudes toward safer and more sustainable travel, underscoring the imperative of robust media strategies during global challenges. For instance, these technologies can estimate a tourist's carbon footprint and recommend eco-friendly travel alternatives. However, the effectiveness of these tools ultimately depends on the quality of information provided and the consumer's willingness to make sustainable choices (Masson, 2024).

Policy and Industry Practices Media plays a significant role in influencing policy and industry practices related to sustainable tourism. Government officials rely on public discourse, often shaped by media narratives, to ensure that sustainability principles are integrated into tourism sector legislation. For example, consistent media promotion of environmental stewardship has notably influenced the development of China's green aviation and Brazil's ecotourism strategies (Zhang, 2024). For their part, organizations often adopt green technologies and methods in response to both regulatory demands and evolving customer needs. The synergy between media and policy can thus drive substantial changes in tourism practices, exemplified by BRICS+ nations' collaborative ventures in green technology (Seyfi & Hall, 2024).

These concepts are discussed as related yet overlapping, constituting an integrated and evolving model where media and technology serve as crucial means for promoting sustainable tourism. Media framing influences public perception and governmental goals, while smart technologies provide the tools to achieve these objectives. Consumer behavior critically links these elements, transforming mere awareness into tangible sustainable actions. Ultimately, policy and industry practices formalize these changes, effectively closing the sustainability feedback loop and establishing sustainability as a cornerstone for tourism development.

Visual representation of the Conceptual Framework for Sustainable Tourism in BRICS+ Countries

To holistically capture the interconnected dynamics of media, smart technologies, consumer behavior, and sustainability governance within the BRICS+ tourism landscape, the study proposes a conceptual framework. This model visually maps the interdependencies that drive sustainable air travel and tourism narratives across emerging economies.

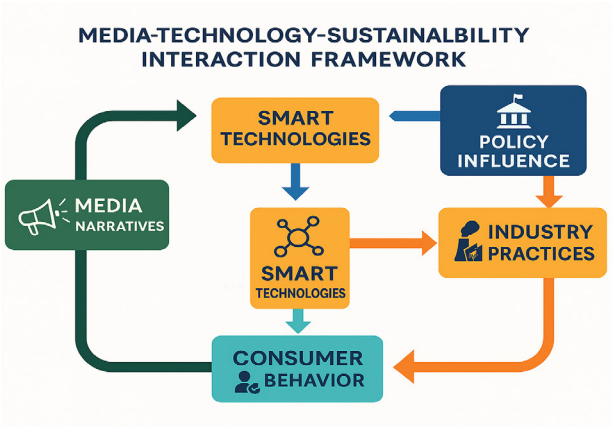

Figure 1 – Media-technology-sustainalbility interaction framework
Note – complied by authors

This framework not only synthesizes the core findings of the study but also offers a strategic lens through which policymakers, industry actors, and researchers can understand and influence sustainable tourism practices in the digital era. It serves as a blueprint for guiding inclusive and innovation-driven transitions in BRICS+ tourism governance.

H*ow media has impacted various aspects of tourism and sustainability:*

Media plays a pivotal role in shaping perceptions, behaviors, and policy responses related to sustainable tourism. Through its capacity to inform, frame narratives, and mobilize collective awareness, media has significantly influenced tourism practices across diverse global contexts. The following examples illustrate the breadth of the media's impact:

1. Promoting Sustainable Tourism as a Social Responsibility

Illustrative Case: The COVID-19 Pandemic and the Rise of "Staycation" Culture

During the COVID-19 pandemic, widespread media coverage emphasized the environmental benefits of reduced international travel, notably lower greenhouse gas emissions and improved air quality. Platforms ranging from traditional news outlets to social media catalyzed a shift in public discourse, promoting localized travel or "staycations" as both a health-conscious and environmentally responsible choice (Gössling et al., 2021).

Impact: This media-driven trend heightened public awareness of eco-friendly travel alternatives and encouraged support for local economies, reinforcing tourism as a socially responsible endeavor.

2. Promoting Ecotourism

Illustrative Case: Costa Rica's Government-Led Ecotourism Campaigns

The Costa Rican government, leveraging global media platforms including National Geographic and BBC Travel, positioned the nation as a premier destination for ecotourism. These media campaigns highlighted the country's biodiversity, conservation initiatives, and sustainability management practices (UNWTO, 2020).

Impact: As a result, there was a significant rise in eco-conscious tourism, which contributed to environmental protection and increased economic returns from sustainable tourism activities.

3. Influencing Consumer Behavior

Illustrative Case: The Swedish 'Flygskam' (Flight Shame) Movement

The Swedish media played a crucial role in popularizing the concept of Flygskam, or flight shame–a grassroots movement discouraging short-haul air travel in favour of low-emission alternatives like rail transport. This narrative gained widespread traction through both mainstream and social media (Seyfi & Hall, 2024).

Impact: The campaign led to a measurable decline in domestic air travel in Sweden and an uptick in investments toward railway infrastructure, demonstrating how media narratives can influence consumer choices and infrastructure development.

4. Media Exposing Unsustainable Business Practices

Illustrative Case: Palm Oil and Deforestation Campaigns

Investigative journalism and documentaries–such as the BBC's "The Burning Issue"–have uncovered the environmental destruction linked to tourism-driven demand for unsustainable palm oil. These reports highlighted how deforestation in Southeast Asia is often fuelled by tourism-related industries (Masson, 2024).

Impact: Public awareness campaigns spurred global consumer protests and compelled corporations to adopt certified sustainable palm oil sourcing practices, illustrating media's power in holding businesses accountable.

5. Media-Induced Policy and Industry Changes

Illustrative Case: Blue Flag Beach Certification Initiatives

Media coverage of Blue Flag beach certifications–a globally recognized eco-label for clean and sustainable beaches–has exerted pressure on local governments and tourism boards to comply with environmental standards related to water quality, waste management, and biodiversity protection (UNWTO, 2020).

Impact: In countries like Greece and Spain, media attention led to improved environmental stewardship and strengthened the eco-tourism brand appeal, aligning tourism development with sustainability goals.

6. Showcasing Technological Solutions for Sustainable Tourism

Illustrative Case: Virtual Reality (VR) Tourism during the Pandemic

As physical travel declined during the pandemic, media outlets and tourism stakeholders promoted virtual tourism experiences, such as virtual safaris and online museum tours. These initiatives highlighted how technology can provide immersive, educational experiences with minimal environmental impact (Xiang & Fesenmaier, 2023).

Impact: This media-driven promotion of VR tourism not only sustained public interest in global destinations but also expanded public understanding of how technology can contribute to low-impact, sustainable tourism.

7. Combating Greenwashing through Media Accountability

Illustrative Case: Social Media Activism against False Sustainability Claims

Social media platforms, particularly Twitter and Instagram, have become tools for public scrutiny and corporate accountability. Citizen journalists and environmental activists have exposed inconsistencies in airline companies' carbon offset claims, initiating widespread backlash and demands for transparency (Becken & Hay, 2012).

Impact: These media-led accountability efforts have led to increased public skepticism of corporate

sustainability claims, encouraging more rigorous sustainability reporting and regulation across the tourism sector.

Synthesis of Media's Influence

These case studies collectively underscore the multifaceted influence of media on tourism and sustainability. From shaping consumer behaviors to prompting institutional reforms and technology adoption, media remains a central actor in the global push for sustainable tourism. The following table synthesizes the cases to illustrate their diverse contexts and tangible outcomes.

The following table offers a tabular representation of the case studies thereby giving a clear perspective of how media has shaped tourism practices across the world.

Table 1 – Case Studies showcasing media's role in influencing tourism practices globally

Case Study	Context	Media's Role	Impact	Lesson	References
Flight Shame Movement (Sweden)	Encouraged travelers to avoid flights due to carbon emissions.	Media promoted the term *flygskam* and highlighted low-carbon alternatives like trains.	4% decline in domestic flights, increased rail investments, inspired similar movements globally.	Media creates social pressure to shift consumer behavior and influence policies.	Gössling et al. (2021).
Costa Rica's Ecotourism Branding	Positioned Costa Rica as a leader in ecotourism.	National Geographic and BBC Travel showcased biodiversity, carbon neutrality, and eco-lodges.	Boosted GDP by 6%, increased eco-tourism traffic, reduced deforestation by over 50%.	Media campaigns can position countries as sustainable tourism leaders, benefiting the economy.	UNWTO (2020).
Blue Flag Certification	Certification for beaches meeting sustainability standards.	Promoted as eco-friendly destinations in travel blogs, documentaries, and news outlets.	Boosted tourism in Greece and Spain, encouraged environmental policy adoption for maintaining certification.	Media exposure can drive environmental policies and attract eco-conscious travelers.	UNWTO (2020).
Palm Oil and Deforestation	Highlighted tourism-related demand for unsustainable palm oil.	Investigative journalism and viral campaigns exposed deforestation impacts.	Consumer boycotts, corporate commitments to sustainable palm oil sourcing.	Investigative media holds industries accountable, driving corporate and consumer-level changes.	Masson (2024).
Virtual Tourism in Japan	Kept international tourists engaged during the pandemic.	Media promoted virtual tours of temples, cherry blossoms, and tea ceremonies on YouTube/IG.	1M+ participants, increased post-pandemic interest in visiting Japan, showcased VR's potential to reduce tourism's environmental footprint.	Media amplifies tech-driven solutions to make tourism sustainable and resilient to disruptions.	Xiang & Fesenmaier (2023).
Social Media Activism Against Greenwashing	Airlines overstated sustainability claims.	Influencers and activists exposed discrepancies on Twitter and Instagram.	Greater transparency, improved corporate reporting of carbon emissions, discerning eco-conscious consumers.	Social media holds corporations accountable and promotes transparency.	Becken & Hay (2012).
"Don't Mess with Texas" Campaign	Reduced littering across highways through cultural pride and humor.	Celebrities featured in anti-littering campaigns via TV, radio ads, and billboards.	72% reduction in highway litter within a decade, became a global model for environmental campaigns.	Culturally resonant campaigns shift public attitudes effectively.	UNWTO (2020).
Responsible Tourism in Bhutan	Promoted «High Value, Low Impact» tourism for preservation.	National Geographic highlighted cultural heritage and limited tourist inflow policies.	Maintained carbon-negative status, preserved culture, boosted revenue through tourism fees.	Media can encourage innovative policies by spotlighting successful national strategies.	Gössling (2023).

Note – complied by authors

The compiled case studies reinforce the central thesis of this paper: that media functions not merely as a passive reflector of public discourse, but as an active agent shaping the trajectory of sustainable tourism. Whether through amplifying grassroots environmental movements, exposing unsustainable corporate practices, or promoting technological alternatives such as virtual tourism, media interventions have demonstrated measurable impacts on consumer behavior, industry adaptation, and policy formation. These examples also highlight the dual potential of media – to empower transformative sustainability narratives or, conversely, to facilitate greenwashing when unchecked. For BRICS+ nations, where tourism intersects with diverse socioeconomic and ecological realities, strategically harnessing media for sustainability goals is not optional – It is imperative. Future policy and practice should thus integrate media strategies that are inclusive, evidence-based, and locally resonant to support a resilient and regenerative tourism sector.

How Media Shapes Policy Changes

This paper aimed at examining how the changes in media coverage affect public policies and their implementation to discover that media remains a significant actor in policy making and has the potential to drive change. Here's a detailed explanation of the mechanisms through which media impacts policymaking:

1. Promoting Policy Deficit Awareness

Media remind and recall existing gaps in policies to the public and policymakers. Situations exposing fraud and scandals, which organized oversight calls for government intercession, are usually depicted in investigative journalism, documentaries, and news reports. Example: Exposes about deforestation for tourism development in South-east Asia have led to better policies and industry responsibilities (Masson, 2024).

2. Influencing Public Opinion

Media influences the views of the members of society by presenting certain problems in a particular manner, thus leading to the development of support for or opposition to policy. Example: The flygskam in Sweden fueled by the media narrative of climate change that put social pressure towards travelling through the flight restriction that reduced air travel demand and provided more funding towards railway construction (Gössling et al., 2021).

3. Amplifying Advocacy Efforts

Public campaigns mostly use the media to convey their agenda to the target groups. Activists are able to reach a large audience and apply pressure on policymaking through the use of social media in particular, and at a very low cost. Example: Hashtags on both Instagram and Twitter pointed out the falsehoods of airlines regarding their carbon offset schemes, and in turn forced companies to become more responsive to corporate accountability and more strict, formal guidelines for sustainability reporting (Becken & Hay, 2012).

4. Setting the Policy Agenda

Media, in other words, decided which problems should be given attention. Officials use media content to identify public issues of interest to citizens and to set the legislative agenda. Example: Ample coverage of the Blue Flag beach certification program pressured governments in Greece and Spain to uphold higher compliance with environmental standards to maintain their certifications (UNWTO, 2020). Paul and Rena (2024[c]) illustrate how national frameworks like India's Viksit Bharat 2047 are embedding sustainability and digital innovation at the core of governance transformation–mirroring similar efforts across BRICS+ nations. In regions with limited institutional support, digital crowdfunding platforms have emerged as enablers of community-based sustainable tourism ventures by broadening access to capital and global audiences (Paul & Rena, 2024[c]).

5. Offering Research-Based Information

In this case, facts, figures and findings are used from written academic papers, opinions from professional practitioners and articles and case studies to support policy issues. Such knowledge can help policy makers to come up with solutions that can be proven effective in the field. Example: Articles highlighting the successes of Costa Rica in utilizing sustainable tourism have been used to encourage other nations to come up with similar polices and policies (UNWTO, 2020).

6. Generating Political Will

Protest is a way through which the media can make politicians and other industry heads act on environmental and social issues which they might not want to address. Example: Due to awareness created by the media in relation to climate change and the impact of tourism, many countries have set carbon neutrality objectives such as Bhutan's tourism policy coined "High Value, Low Impact" tourism.

7. Supporting International Engagement

Other examples shown in the media should be used by policymakers as a guideline to emulate those countries whose measures they borrowed. It promotes debates on issues such as climate change, sustainability of tourism and tourism development.

Example: Reporting of Sweden's climate friendly measures such as carbon taxes has impacted on similar measures adopted by other countries in Europe (Gössling et al., 2021). Media acts as an intermediary between the public, interest groups and policy makers; thus, making sure that deserving causes are addressed. Through framing stories, giving voice to some and silencing others and creating an environment of responsibility, the media plays an influential role in the policy context particularly for sectors such as tourism and sustainability. Nevertheless, the problem arises of how to maintain the influence of the media together with the provision of accurate information to prevent mere promotional publications made in the form of 'green' content.

Trends for Media within Sustainable Tourism and Policy Framing for the Future

The roles of media, technology and sustainable tourism are dynamic and are changing at a faster pace. Future trends reveal that the media is set to change the behavior of society, how industries operate, and policies are made. Here are the key future trends to watch:

1. Increase of Immersive Technologies Usage

Trend: Augment reality and virtual reality will become popular for traveling since customers will be able to sample some destinations ahead of real events. *Impact:* Reduces the CO_2 emissions resulting from exploratory travel through availing work-related virtual substitutes. Allows the promotion of sustainable tourism by providing the outcomes of the tourists' activities. Example: Literature suggested that using Virtual Reality to create tours to heritage sites may inform travelers of preservation requirements while offering a fulfilling encounter without interacting with the tangible environment (Xiang & Fesenmaier, 2023; Rena, 2024).

2. AI in its broad sense

Trend: AI technologies will advance, and consumers will be able to get more customized, real-time experiences, that are also sustainable (Rena, 2024). *Impact:* Personalized suggestions concerning the usage of environmentally friendly products. Improved opportunity to factor the environmental costs for travel decisions. Example: Self-driving apps that count and pay for carbon footprint will equip travelers with tools to make more sustainable decisions (Hamid et al., 2023).

3. Blockchain for Transparency – Improvement

Trend: Here, blockchain technology will be used to independently confirm the sustainability of products and services so that the level of greenwashing will be minimized. *Impact*: Enhancements of credibility of the consumers about the eco-certifications and offset programs. Strengthens response – ability and responsibility within the tourism sector. Example: Real-time tracking of carbon credits and sustainable certifications using blockchain systems can help travelers to be confident of authenticity of environmental stewardship claimed by industry (Becken & Hay, 2012).

4. Hyperlocal Tourism and Resident Economic Enhancement

Trend: Media will pay more attention to the development of niche tourism especially domestic tourism promoting small scale tourism. *Impact:* Reinforces the local economy by direct revenue that will be used to fund projects in those areas. Minimizes intrusive tourism and maintains cultural and other resource value. Example: This makes impeccable sense, especially with increased campaigns on cultural tourism such as in the Gross National Happiness country of Bhutan (Gössling, 2023).

5. Policy-Creating Partnership through Media

Trend: Multimedia marketing will foster global cooperation on sustainable policies in tourism. I*mpact:* Explores opportunities of linking global tourism practices with sustainable development goals (SDGs). Presses countries into adopting set policies on eco-tourism. Example: Reporting on Sweden's climate efforts has already prompted other countries to act in a similar manner (UNWTO, 2020).

6. Data-Driven Storytelling

Trend: Media consumption: big data analytics – will improve a narrative, meaning media can offer better narrative that is precise and customized(Rena, 2024). *Impact:* This increases public engagement since the content organization can target different audiences. Enhances the advocacy efforts by presenting a numeric summary of the company's sustainability measures. Example: Thus, platforms using data on travel intentions will develop campaigns for promotion of green tourism (Hamid et al., 2023).

7. Focus on Regenerative Tourism

Trend: The media will move from increasing awareness about sustainability to raising awareness for regenerative tourism, which is the act of making places even better than they were found. *Impact:* Promotes users within the tourism sector, as well as enterprises, participating in processes of environmental reconstruction, and the construction of communities. Opens the sustainability concept beyond mere preservation to active enhancement. Example: Campaigns promoting coral reef restoration projects in line with tourism promotions will become more popular (Gössling et al., 2021).

8. A Revised Role of Social Media in Activism

Trend: Social media apps will continue to be used to increase awareness, pressure corporations and governments over their sustainability promises. *Impact:* Ensures that the voices of groups that suffer the impacts of unsustainable tourism are heard. Improves the level of transparency by providing information in real time realize. Example: Campaigns revealing environmental breaches will spur fast industry and policy reactions as witnessed with airline carbon offset criticisms (Masson, 2024). Technology continues to play a significant role for the media in sustainable tourism; there is more transparency than before, and consumers are more privileged. During the advancement of the tourism industry, the media will remain to be influential in advocating for sustainable policies, policies on ethical tourism, and encouraging travelers in the use of regenerative tourism.

Critical Analysis

Analysis of these concepts shows that the four concepts are interconnected in media sphere in ways that present a shift towards media and technology and sustainability. Sankar and Ilangovan (2025) have pointed at the innovative role of smart technologies, but the opponents insist that the use of such technologies is more restrained by the spheres of activity. In the same way, although there is increased awareness levels, the changes in behavior as well as in the adoption of policies have not followed this trajectory (Masson, 2024). These challenges sum up the need to take an integrated approach that will focus on the potential of media and technology within as well as the constraints in promoting sustainable tourism.

This study's literature review focuses on the various approaches and theoretical viewpoints that underpin it. By synthesizing these insights, the research aims to address the central question: What is the role of media and smart technologies for the change in air travel and sustainability discourses in the BRICS+ countries? This question drives the subsequent research and serves as a base for coming up with concrete recommendations for policymakers, industries, and media personnel.

Methodology

This study investigates the central research question: *In what ways do media and smart technologies enhance air travel and tourism sustainability discourses in BRICS+ countries?* To address this inquiry, a secondary data analysis was employed, drawing from a diverse body of peer-reviewed journal articles, policy documents, media reports, and technology-based case studies. The temporal scope of the data spans from 2015 to 2024 – a decade marked by significant advancements in smart technologies and a heightened global focus on sustainability challenges.

The study focuses on BRICS+ countries, which include the core BRICS members – Brazil, Russia, India, China, and South Africa–along with other strategic partner countries participating in expanded cooperation initiatives. These nations offer a compelling research context due to their shared yet diverse socio-economic, political, and environmental dynamics. As emerging economies with growing tourism sectors and distinct geopolitical leverage, BRICS+ nations reflect the global complexities of sustainable development.

The data corpus comprises 106 documents, including academic publications, policy frameworks, and industry reports sourced from Scopus, Web of Science, and ResearchGate. Key scholarly sources include Sankar and Ilangovan (2025) on the role of smart technologies; Seyfi and Hall (2024) on geopolitical narratives in tourism; and Masson (2024) on the media's contribution to sustainability discourses. Additionally, media texts from major news outlets, national tourism boards, and government-sponsored sustainability campaigns across BRICS+ countries were reviewed for thematic relevance.

To analyze the collected data, the study employed a combination of qualitative tools designed to uncover both depth and comparative breadth in sustainability discourse. Content analysis was used to identify dominant media frames, recurring narratives, and discursive patterns related to sustainable tourism messaging. In parallel, thematic analysis was applied to academic and policy literature to extract underlying themes, relational dynamics, and latent meaning structures, following Braun and Clarke's (2006) six-phase model. Additionally, the Sustainability Narratives Analysis Tool (SNAT) was utilized to compare sustainability discourses across the BRICS+ countries, enabling the identification of regional variations and commonalities in sustainability communication. The selection of these analytical tools was guided by their methodological robustness and their alignment with best practices in qualitative research, as outlined by Krippendorff (2018) and Braun and Clarke (2006).

Target Population and Data Validation

The study focuses on actors with direct influence over sustainable tourism strategies: policy-

makers, tourism industry professionals, and media practitioners within BRICS+ countries. This purposive sampling is grounded in the pragmatic logic of stakeholder relevance, as outlined by Creswell and Creswell (2017).

To ensure reliability and validity, all data were systematically cleansed – removing duplicates and verifying source authenticity. Triangulation techniques were applied through cross-referencing multiple data sources and analytical frameworks, following the methodological recommendations of Denzin (2012).

Theoretical Foundation

The analysis is grounded in media framing theory, which examines how specific aspects of reality are emphasized or omitted in media narratives to influence audience perception and behavior (Entman, 1993). Within the context of this study, media framing theory serves as a lens through which to understand how sustainability narratives are constructed, transmitted, and internalized by various stakeholders.

By integrating media framing theory with insights from sustainability science and tourism studies, this methodology enables a multidimensional examination of how media and smart technologies shape sustainable tourism practices in BRICS+ nations. This interdisciplinary approach supports a comprehensive exploration of media's catalytic role in advancing environmental, economic, and cultural sustainability.

Results and discussion

The principal finding of this study is the identification of dominant media narratives that actively promote sustainable tourism within BRICS+ countries. These narratives frequently emphasize themes such as environmental preservation, cultural heritage, and community engagement (Seyfi & Hall, 2024; Sankar & Ilangovan, 2025). Their presence across diverse media platforms signals a growing capacity to influence public perception and behavior toward sustainability-oriented goals. For instance, ecotourism campaigns in countries such as India and Brazil have contributed to raising awareness around local conservation efforts, thereby fostering eco-consciousness among both domestic and international travellers.

These findings align closely with the theoretical framework of media framing, as outlined in the literature review, wherein media narratives are understood to shape discursive environments that influence consumer choices and institutional responses. Environmentally conscious tourists, as shaped by these narratives, tend to favour eco-friendly travel options. In turn, industries respond to this consumer demand by integrating sustainable practices and technologies – such as energy-efficient systems or green certification schemes – into their operations. This illustrates a feedback loop between media narratives, consumer behavior, and industry adaptation.

In support of these observations, the study further highlights the pivotal role of smart technologies in enhancing sustainable tourism experiences. Innovations such as virtual reality (VR) and artificial intelligence (AI) offer environmentally responsible alternatives by minimizing physical footprints while maintaining experiential value. Blockchain-enabled platforms not only enhance data transparency but also support verifiable eco-certification systems for sustainable air travel, a shift explored extensively by Paul and Rena (2024[b]) and Rena (2024) in the context of emerging digital economies. Xiang and Fesenmaier (2023) illustrate how AI applications support personalized and low-impact travel recommendations, while Sankar and Ilangovan (2025) show how virtual tourism of ecologically sensitive areas – such as South Africa's natural reserves – provides immersive experiences without compromising environmental integrity.

Moreover, media coverage has demonstrated considerable influence on policy development within BRICS+ nations. Policies such as China's green aviation initiatives and Brazil's ecotourism frameworks have been informed, in part, by sustained media attention to environmental degradation and the need for sustainable regulation. These examples underscore media's role not only in shaping public opinion, but also in prompting institutional reform and cross-sector collaboration.

However, the study also acknowledges opposing findings. While media narratives often support sustainability, they can inadvertently facilitate greenwashing – the dissemination of unverified or misleading claims about environmental responsibility. As Masson (2024) argues, without enforceable regulatory benchmarks, corporations may exploit sustainability discourse for reputational gain without meaningful action. This critique highlights the need for greater transparency and the development of standardized criteria to assess sustainability claims in tourism marketing.

A secondary but significant finding relates to the emergence of cooperative programs among BRICS+ nations that utilize shared media platforms for sus-

tainability communication. These initiatives enable countries to engage in cross-national benchmarking, promote best practices, and co-invest in sustainable tourism technologies. For example, collaborative efforts between South Africa and India have resulted in joint investments in eco-tourism infrastructure and innovation (Seyfi & Hall, 2024). Such cooperation strengthens regional capacity for sustainability implementation and reflects the strategic importance of media in international development dialogues.

In a preliminary response to the research question, the findings suggest that media and smart technologies hold considerable potential to transform sustainability discourses and practices in air travel and tourism across the BRICS+ context. By shaping public awareness, industry behavior, and policy design, these tools contribute to a more sustainable tourism paradigm. Nevertheless, challenges such as digital inequality and the risk of greenwashing remain significant barriers. The practical impact of media-driven sustainability efforts is likely to vary by country, depending on digital infrastructure, regulatory environments, and cultural readiness to adopt green tourism principles. As such, further empirical research is needed to evaluate the contextual uptake of sustainability narratives, particularly in less digitized BRICS+ economies.

Proposed Model

Building upon the findings and thematic insights of this study, a conceptual framework – the Media-Technology-Sustainability Interaction Model – is proposed to explain the dynamic interplay between media narratives, smart technologies, consumer behavior, industry practices, and policy interventions in promoting sustainable tourism within BRICS+ countries. The model integrates theoretical constructs from media framing, sustainability science, and smart tourism to illustrate how information flows and digital innovations co-shape environmentally responsible practices. By mapping these relationships, the framework offers a comprehensive lens to understand how sustainable tourism discourse is constructed, disseminated, and institutionalized across diverse socio-political contexts. It further serves as a strategic guide for researchers, policymakers, and industry actors seeking to operationalize sustainability goals through effective media engagement and technological innovation.

Model:

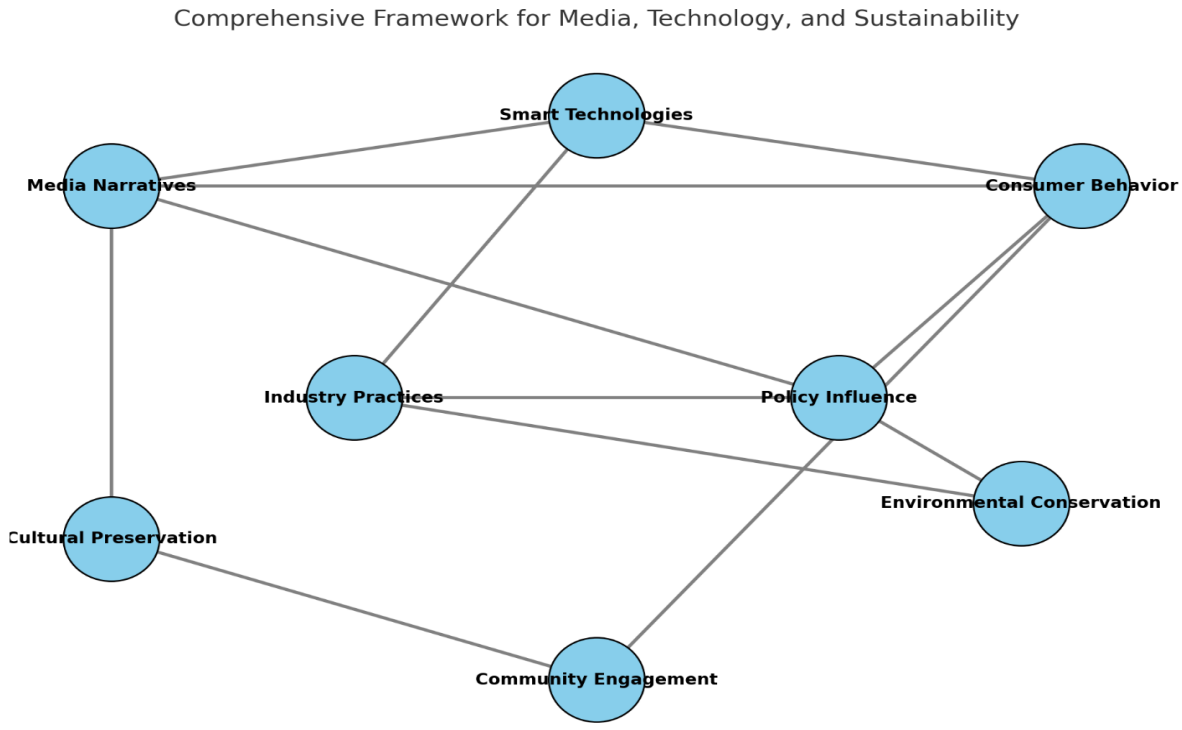

Figure 2 – Comprehensive Framework for Media, Technology and Sustainability
Note – compiled by authors

Components:

The proposed Media–Technology–Sustainability Interaction Framework illustrates the complex yet interconnected roles of media narratives, smart technologies, consumer behavior, industry practices, and policy interventions in promoting sustainable tourism across BRICS+ countries. This model is grounded in the understanding that sustainability is not a linear goal, but a dynamic and ongoing process shaped by communication, innovation, and stakeholder engagement.

Media Narratives form the starting point of this interaction. Through their emphasis on environmental stewardship, cultural preservation, and inclusive development, media platforms set the tone for how sustainability is perceived and prioritized. By framing sustainability as both a moral imperative and a practical goal, media influence the design and dissemination of technologies and help cultivate eco-conscious behaviors among consumers.

Smart Technologies – such as Virtual Reality (VR), Artificial Intelligence (AI), and the Internet of Things (IoT)–serve as enablers of sustainable tourism by offering immersive educational experiences, reducing the need for physical travel, and optimizing resource use. These technologies not only support environmental conservation but also stimulate innovation in the tourism and aviation sectors by enabling new forms of engagement that are less intrusive to ecosystems.

Consumer Behavior is both influenced by and a driver of media and technological trends. As consumers are increasingly exposed to narratives promoting environmental responsibility and offered tech-enabled tools for sustainable choices, their preferences shift toward eco-friendly products and experiences. This growing demand exerts pressure on both public and private institutions to respond with appropriate strategies and offerings.

Industry Practices adapt in response to both market signals and regulatory expectations. Companies across the tourism value chain are beginning to adopt green technologies, sustainable supply chain models, and certification standards to remain competitive and align with evolving consumer values. Such adaptations lead to measurable outcomes, including reduced emissions, improved energy efficiency, and enhanced community relations.

Policy Influence is shaped by public discourse, often driven by media coverage and consumer advocacy. Informed citizens and empowered consumers increasingly shape the policy agenda, prompting governments to implement stronger environmental regulations and sustainability incentives. This reinforces a feedback loop in which policy supports industry transformation and facilitates broader public engagement.

The model also incorporates Sustainability Goals, particularly the dual objectives of environmental conservation and cultural preservation. Media stories that valorize indigenous knowledge, historical heritage, and ecosystem services contribute to a more holistic view of sustainable tourism. Ecotourism and community-based tourism initiatives are aligned with these goals, offering inclusive benefits to local stakeholders while preserving natural and cultural capital.

Community Engagement represents a vital pillar of the model, emphasizing the importance of involving local populations in sustainability efforts. Media campaigns and policy frameworks that prioritize equity and participation help ensure that the economic, environmental, and cultural benefits of tourism are shared more broadly and justly. Local voices, when amplified by media and supported by enabling policies, contribute to a more resilient and inclusive tourism economy.

How the Framework Functions

At its core, the framework demonstrates a cyclical and mutually reinforcing process:

- *Media Narratives* initiate the discourse, shaping awareness, values, and the innovation agenda.

- *Smart Technologies operationalize these narratives by offering practical tools and scalable solutions.*

- *Consumer Behavior* responds to these stimuli, driving demand for sustainable alternatives.

- *Industry Practices and Policy Interventions* evolve in response, creating structural support for sustainability.

Together, these components drive progress toward the three pillars of sustainable development–economic viability, social equity, and environmental integrity. The model reinforces the understanding that tourism sustainability cannot be achieved through isolated efforts. Rather, it requires a coordinated interaction of media systems, technological advancement, institutional adaptation, and citizen participation. In the BRICS+ context, where structural disparities and innovation capacities vary, this integrated approach offers a flexible yet robust pathway for advancing sustainability in tourism and air travel.

Conclusion

Media narratives act as powerful catalysts in shaping public consciousness and guiding the trajectory of sustainable tourism. As communicative discourses, they can either open or restrict the space for sustainability by framing cultural, environmental, and community values in ways that influence behavior, attitudes, and ultimately policy. Research has shown that media narratives are not merely reflective but actively constitutive of tourism discourses, driving both public opinion and industry standards toward sustainability goals (Entman, 1993; Seyfi & Hall, 2024). Complementing this communicative force, smart technologies such as virtual reality (VR), artificial intelligence (AI), and big data analytics are increasingly enabling tourism systems to minimize ecological footprints while enhancing visitor engagement through low-contact, energy-efficient experiences (Hamid, Bhat, & Khalid, 2023; Xiang & Fesenmaier, 2023). Together, media and digital innovation have contributed to a broader alignment between public discourse and industry practices, leading to enhanced regulatory frameworks and compliance standards. This shift has been particularly notable in BRICS+ countries, where collaborative governance models have made measurable progress in transitioning toward greener tourism economies (Becken & Hay, 2012; UNWTO, 2020). When these findings are triangulated with existing scholarship, the study supports the views of Seyfi and Hall (2024), who emphasize the instrumental role of media in shaping global tourism policy; Hamid et al. (2023) and Xiang & Fesenmaier (2023), who advocate for the transformative potential of smart technologies; and Becken and Hay (2012), whose work connects sustainable tourism directly to climate adaptation strategies. However, the present study respectfully diverges from Masson (2024), who casts doubt on media efficacy due to risks of greenwashing. While this concern is valid, the current findings suggest that well-calibrated and transparent media campaigns can drive meaningful change in both public policy and industry practice. Ultimately, this paper contributes to the field by proposing a novel conceptual framework that synthesizes media influence, technological enablement, consumer behavior, and policy harmonization to advance sustainable tourism in the BRICS+ context. This integrated model fills a crucial gap in literature by contextualizing sustainability implementation within emerging economies undergoing rapid digital and environmental transformation.

Limitations and Future Validation

While this study presents a promising conceptual framework that integrates media, technology, and sustainability in BRICS+ tourism, the analysis is based on secondary data. The findings are therefore primarily descriptive and interpretive. Empirical validation through field research, interviews, or case studies in BRICS+ countries is recommended to test the framework's robustness and practical applicability. Future work may also involve longitudinal data collection to evaluate real-time media impacts on consumer and policy behavior.

Recommendations

The study recommends that in the future, we change our policies and practices as follows:

This requires the formulation of standardized procedures for assessing the truthfulness of sustainability statements so that the vice of green washing can be checked.

Firmly support the development of solutions that are inclusive and can be integrated on a large scale to provide solutions for digital inequalities and to expand new forms of sustainable mobility.

Strengthen existing and new inter-country cooperation within BRICS+ countries to benchmark and collectively develop sustainability policies.

Future Research Directions

Therefore, after this study has answered its research question, it has developed new questions to be asked in the future. Future research should be investigated:

What applications of the outlined emerging technologies can create more transparency and accountability in sustainable tourism?

The impact of long-term media-oriented campaigns on consumers and their behavior as well as industries.

An analysis of how regional disparities in socioeconomic development affect the progression of sustainable tourism in the BRICS+ countries.

Answering these questions, subsequent research can develop and enhance the integrated framework and contribute to the creation of a more environmentally friendly tourism industry globally.

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SUSTAINABLE DEVELOPMENT OF MORTGAGE LENDING: ECONOMIC CHALLENGES AND PROSPECTS

This article examines the development of mortgage lending in Kazakhstan, focusing on its dynamics and its relationship with key macroeconomic indicators. Special attention is given to the role of government programs and the integration of ESG (Environmental, Social, and Governance) principles to promote sustainability in the sector. While ESG standards are widely adopted in international financial systems, this study analyzes Kazakhstan's unique economic and institutional context. Additionally, Uzbekistan is considered a country where certain effective financial and regulatory tools applied in Kazakhstan could potentially be adapted to local conditions.

The analysis compares selected mortgage lending indicators between Kazakhstan and Uzbekistan and employs correlation and regression modeling to evaluate how macroeconomic variables such as GDP, interest rates, and the share of overdue loans impact mortgage lending volumes. Drawing on data from The Global Economy (2023), the study explores how mortgage programs in developed countries affect the ratio of banking sector assets to GDP, providing a global benchmark.

A detailed analysis of mortgage trends from 2007 to 2023 reveals important patterns and correlations between macroeconomic factors and mortgage loan dynamics in both countries. Time series and correlation methods allowed the authors to establish statistically significant relationships, particularly in the case of Kazakhstan. As a result, a forecasting model was developed, incorporating GDP growth, lending interest rates, and the level of non-performing loans as independent variables.

The article also discusses the integration of ESG standards into Kazakhstan's mortgage finance system, highlighting their potential to foster green construction and sustainable housing development. These initiatives support broader sustainable development objectives and could be relevant for Uzbekistan as well. The authors argue that implementing green financial instruments such as green mortgages and funding programs for energy-efficient housing can reduce environmental harm and improve housing affordability in Kazakhstan, Uzbekistan, and other emerging economies.

Keywords: mortgage lending, sustainable development goals (SDGs), ESG standards, GDP, socio-economic development, Kazakhstan.

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Ипотекалық несиелендірудің тұрақты дамуы: экономикалық қиындықтар мен болашағы

Бұл мақалада Қазақстандағы ипотекалық несиелендірудің дамуы, оның серпіні және негізгі макроэкономикалық көрсеткіштермен байланысы қарастырылады. Сектордың тұрақты дамуын қамтамасыз етудегі мемлекеттік бағдарламалардың рөлі мен ESG (экологиялық, әлеуметтік және корпоративтік басқару) қағидаттарын енгізуге ерекше назар аударылған. ESG стандарттары халықаралық қаржы жүйелерінде кеңінен қолданылғанымен, бұл зерттеу Қазақстанның экономикалық және институционалдық ерекшеліктерін талдайды. Сонымен қатар, Өзбекстан – Қазақстанда қолданылған тиімді қаржылық және реттеуші құралдарды жергілікті жағдайға бейімдеуге болатын ел ретінде қарастырылады.

Талдау барысында Қазақстан мен Өзбекстан арасындағы ипотекалық несиелендірудің кейбір көрсеткіштері салыстырылып, ЖІӨ, пайыздық мөлшерлемелер және мерзімі өткен несиелердің үлесі сияқты макроэкономикалық айнымалылардың ипотека көлеміне әсері корреляциялық және регрессиялық модельдер арқылы бағаланады. The Global Economy (2023) деректеріне сүйене отырып, зерттеу дамыған елдердегі ипотекалық бағдарламалардың банк секторы активтерінің ЖІӨ-ге қатынасына қалай әсер ететінін қарастырады.

2007–2023 жылдар аралығындағы ипотекалық үрдістерді егжей-тегжейлі талдау Қазақстан мен Өзбекстандағы негізгі экономикалық көрсеткіштер мен ипотекалық несиелер арасындағы маңызды байланыстарды көрсетті. Уақыттық қатарлар мен корреляциялық әдістер Қазақстан жағдайында айтарлықтай статистикалық маңыздылықты айқындады. Нәтижесінде ЖІӨ өсімі, пайыздық мөлшерлемелер және проблемалық несиелер деңгейі сияқты айнымалыларды қамтитын болжамдық модель жасалды.

Мақалада ESG стандарттарының Қазақстанның ипотекалық қаржы жүйесіне енгізілуі және олардың «жасыл» құрылыс пен тұрақты тұрғын үйді дамытуға қосқан үлесі де қарастырылады. Мұндай бастамалар тұрақты даму мақсаттарына сәйкес келеді және Өзбекстан үшін де өзекті. Авторлар «жасыл» ипотека және энергия үнемдейтін тұрғын үйлерге бағытталған қаржылық құралдарды енгізу экологиялық зиянды азайтып, тұрғын үйдің қолжетімділігін арттырады деп пайымдайды.

Түйін сөздер: ипотекалық несиелеу, тұрақты даму мақсаттары (ТДМ), ESG – стандарттар, ЖІӨ, елдің әлеуметтік-экономикалық дамуы, Қазақстан.

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Устойчивое развитие ипотечного кредитования: экономические вызовы и перспективы

Данная статья рассматривает развитие ипотечного кредитования в Казахстане, с акцентом на его динамику и взаимосвязь с ключевыми макроэкономическими показателями. Особое внимание уделено роли государственных программ и интеграции принципов ESG (экологических, социальных и управленческих) для обеспечения устойчивости в секторе. Несмотря на широкое распространение стандартов ESG в международной финансовой практике, исследование сосредоточено на специфике экономических и институциональных условий Казахстана. Наряду с этим, в качестве страны для возможной адаптации успешных казахстанских инструментов рассматривается Узбекистан.

Анализ включает сравнение отдельных показателей ипотечного кредитования в Казахстане и Узбекистане, а также применение корреляционно-регрессионного моделирования для оценки влияния таких макроэкономических переменных, как ВВП, процентные ставки и доля просроченной задолженности, на объемы ипотечного кредитования. На основе данных The Global Economy (2023) исследуется, как ипотечные программы в развитых странах влияют на соотношение активов банковского сектора к ВВП, что позволяет установить глобальный ориентир.

Детальный анализ ипотечных трендов за период 2007–2023 годов выявил важные закономерности и взаимосвязи между макроэкономическими факторами и динамикой ипотечного кредитования в обеих странах. Методы временных рядов и корреляционного анализа позволили установить статистически значимые зависимости, особенно в казахстанском контексте. В результате была разработана прогностическая модель, включающая рост ВВП, процентные ставки и уровень проблемных кредитов в качестве независимых переменных.

В статье также рассматривается процесс интеграции ESG-стандартов в систему ипотечного финансирования Казахстана, с акцентом на продвижение “зеленого” строительства и устойчивого жилищного развития. Эти инициативы соответствуют целям устойчивого развития и актуальны для Узбекистана. Авторы утверждают, что внедрение таких финансовых инструментов, как “зеленая” ипотека и программы финансирования энергоэффективного жилья, позволит сократить экологический ущерб и повысить доступность жилья в Казахстане, Узбекистане и других развивающихся странах.

Ключевые слова: ипотечное кредитование, цели устойчивого развития (ЦУР), ESG-стандарты, ВВП, социально-экономическое развитие страны, Казахстан.

Introduction

The mortgage lending market plays a crucial role in the socio-economic development of countries. It stimulates construction activity, affects employment, and serves as an essential financial instrument to improve housing conditions. Kazakhstan has actively integrated the Sustainable Development Goals (SDGs) into national policy, emphasizing access to affordable housing (SDG 11), economic growth (SDG 8), and support for green technologies (SDG 13). This article analyzes the dynamics of mortgage lending in Kazakhstan and, to a limited extent, Uzbekistan. It evaluates the influence of

macroeconomic indicators, state programs, and the implementation of sustainable financial instruments, especially green mortgages, on the housing finance system.

According to the report (CCA Kazakhstan, 2023), Kazakhstan is actively integrating the Sustainable Development Goals (SDGs) into its national strategy. In this context, mortgage lending plays an important role in achieving a number of SDGs:

- SDG 1 "Eradicate poverty", as mortgage lending contributes to poverty reduction by increasing housing affordability;
- SDG 8 "Decent Work and Economic Growth" as mortgage programs and projects affect GDP and stimulate the construction industry;
- SDG 11 "Sustainable Cities and Human Settlements", as mortgage lending is an important tool for creating affordable and sustainable housing for the country's population.

In addition, the achievement of SDG 7 "Affordable and Clean Energy" and SDG 13 "Climate Action" is particularly relevant. In this context, the development of green mortgages and the financing of energy efficient housing serve as important tools to promote sustainable development in any country.

Government regulation of the mortgage market determines the range of financing instruments available to market participants and aims to enhance housing affordability while ensuring stable demand (Yermilova, 2019). For example, as Kazakhstan strives for carbon neutrality by 2060, the integration of ESG standards into mortgage lending – particularly through the issuance of green bonds and support for energy-efficient construction – has become a key step toward sustainable development.

Literature review

The development of mortgage lending has been extensively studied in both developed and emerging economies. International experience shows that mortgage availability is closely tied to government policies, macroeconomic stability, and financial market maturity. According to reports by the International Monetary Fund (IMF, 2019) and the World Bank (WB, 2022), mortgage growth contributes significantly to GDP expansion, employment, and housing affordability.

Mortgage lending is considered a crucial component of the mortgage system, as it allows citizens to either acquire new housing or improve existing conditions by leveraging borrowed funds. In the view of F. Carozzi, numerous government initiatives across countries are designed to stimulate both supply and demand in mortgage lending. These include mortgage interest tax exemptions (e.g., USA, India, Sweden), state loan guarantees (USA, Netherlands), and subsidized loan programs (France, UK), all aimed at reducing the overall cost of housing acquisition (Carozzi, 2024).

According to B.J. Keys, the effectiveness of housing policy also depends on the financial behavior and literacy of households, as well as their willingness to make rational long-term financial decisions (Keys, 2016). The mortgage process involves the successful execution of real estate purchase transactions with credit mechanisms, requiring well-coordinated procedures and institutions (Averyanova, 2008).

In the context of project management, R. Müller emphasizes that different real estate projects require distinct success criteria depending on their type and industry context (Müller, 2016). According to A. Koblyakova, the distribution of mortgage contracts can vary significantly between regions due to differing policy environments and structural economic factors (Koblyakova, 2014). As stated by A.C. Goodman, homebuyers plan multi-year residency and housing decisions based on income expectations, regional prices, and preferences – especially when transaction costs are present (Goodman,1920).

In terms of sustainability and ESG integration, S. Liu argues that banks with high ESG performance are more cautious in selecting borrowers, closely monitor loan disbursement and usage, and demonstrate lower default rates (Liu, 2023). The author Q. Wang believes that banks with lower return on equity (ROE) tend to pursue ESG improvements to enhance their public image and demonstrate commitment to sustainability (Wang, 2023). According to the observation of Y. Shi, China's capital market provides a unique case for studying the economic impact of ESG-oriented investments on the banking sector (Shi, 2024). B. Rahat also notes the increasing importance of adhering to international ESG reporting standards to ensure financial transparency and long-term resilience (Rahat, 2023).

Finally, according to Bezemer, changes in the mortgage lending sector have substantial effects on business credit flows; however, the nature and magnitude of this impact largely depend on the institutional development and structure of the banking system in a given country (Bezemer, 2020).

Methodology

In the research process, along with the description of the study's geographical and economic context, the authors applied a range of methods for identifying key parameters, as well as statistical, mathematical, and analytical tools for processing, interpreting, and summarizing empirical data.

The subject of this study is mortgage lending in the Republic of Kazakhstan, examined through the lens of Sustainable Development Goals (SDGs) and ESG principles, with the goal of deriving applicable insights for the Republic of Uzbekistan.

The study is based on the hypothesis that there exists a statistically significant relationship between key macroeconomic indicators and the share of banking system assets relative to GDP. Specifically, it is assumed that household debt to financial institutions, total loan volumes, and banking assets have a direct positive correlation with mortgage lending, while overdue debt has an inverse relationship.

To support this assumption, the study also presents a comparative analysis of mortgage lending in developed economies (using data from Global Economy, 2023). This analysis illustrates that in many countries, growth in mortgage lending is associated with an increased share of banking sector assets in GDP.

For Kazakhstan, the authors utilized statistical methods and dynamic series analysis to assess the relationship between GDP, the volume of loans by second-tier banks, overdue debt, and banking sector assets. The data were sourced from the official website of the National Bank of the Republic of Kazakhstan.

To forecast the development of mortgage lending in Kazakhstan, a correlation and regression analysis was conducted. The relationship between variables is expressed through the following linear regression model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

where:

Y – Mortgage loan volume (dependent variable)

X_1 – GDP

X_2 – Total HLB credits at the end of the period

X_3 – Overdue debt

X_4 – Assets of banks

ε – Error term

β_0 – Intercept; β_1, β_2, β_3, β_4 – Regression coefficients

Using this model, and considering current trends in GDP, credit expansion, and overdue debt, the study projects the volume of mortgage lending in Kazakhstan for the period 2024–2026. The forecast results are presented in Table 6.

To evaluate the model's adequacy and explanatory power, the coefficient of determination (R^2) was applied. The model with the best statistical fit was selected as the basis for further policy recommendations.

Results and discussion

Mortgage lending is one of the activities of second-tier banks. Projects in mortgage lending are mainly of a long-term nature. In this case, the main rule in project management is, on the one hand, the correct and timely execution of all parts of the project, on the other hand, to stay within the budget and be completed on time or before the deadline (Omar, 2014).

Table 1 shows the countries that have a substantial amount of mortgage loans. The largest countries with a high ratio of bank assets to GDP include South Korea (181.7%), Switzerland (172.5%), Australia (148.2%), Sweden (145.8%), and Canada (141.3%). At the same time, the volume of mortgage loans in local currency amounts to 672,110 billion in South Korea, 81,440 billion in Chile, 18,016 billion in Russia, 5,436 billion in Kazakhstan, and 58.2 trillion in Uzbekistan. However, Uzbekistan's ratio of bank assets to GDP remains low at 35%, indicating a limited capacity of the financial sector to support long-term mortgage growth compared to more developed markets.

The countries with the highest level of problem loans are Greece 8.2%, Russia – 5.5%, Hungary – 3.8%. However, net interest margin was obtained in: Argentina – 10.4%, Turkey – 3.3%, Kazakhstan – 5.5%, Uzbekistan – 6.7%.

The countries with the highest total debt of the population to banks and other financial institutions as a percentage of GDP are as follows: Switzerland – 127.7%, Australia – 110.3% and Canada – 101.4%.

Table 1 – Mortgage lending indicators by country

Countries	Volume, mortgage loans billion, local currency	Problem loans, 2022	Net interest margin, 2021	Total household debt to banks and other financial institutions as a percentage of GDP	Ratio of bank assets to GDP, 2021.
Argentina	274.0	3.1	10.4	3.5	24.2
Australia	2,152.0	0.7	1.7	110.3	148.2
Austria	159.0	2.0	1.1	43.8	104.1
Belgium	230.0	1.8	1.1	58.3	83.0
Canada	1,708.0	0.3	1.6	101.4	141.3
Chile	81,440.0	1.7	2.9	46.2	90.4
Czech Republic	1,757.0	1.5	1.9	30.6	70.8
Finland	106.0	1.4	0.8	63.6	105.1
France	1,287.0	2.1	0.5	61.6	131.1
Germany	1,578.0	1.2	1.0	50.8	95.9
Greece	27.0	8.2	2.1	41.3	73.1
Hungary	5,101.0	3.8	2.1	16.6	57.7
Italy	425.0	2.8	1.1	37.3	115.5
Kazakhstan	5,436.0	3.4	5.5	0.0	30.0
Luxembourg	41.0	1.6	0.9	68.2	103.7
Netherlands	566.0	1.6	1.1	94.9	104.6
Norway	2,869.0	0.3	1.8	87.5	133.8
Poland	447.0	2.4	2.3	23.4	65.8
Portugal	99.0	3.6	1.3	54.5	114.7
Russia	18,016.0	5.5	0.5	22.2	65.6
South Korea	672,110.0	0.2	1.6	92.0	181.7
Spain	490.0	3.1	0.9	46.0	119.7
Sweden	4,124.0	0.3	1.1	83.9	145.8
Switzerland	856.0	0.7	0.8	127.7	172.5
Turkey	401.0	2.0	3.3	10.5	88.8
UK	1,454.0	1.0	1.8	78.8	136.0
USA	2,575.0	0.7	2.8	72.1	74.2
Uzbekistan	58.2	1.4	6.7	14.0	35.0
Note – compiled by the authors based on the source (Forbes Media LLC, 2024)					

Since 2015, Uzbekistan has seen steady growth in the ratio of bank assets to GDP, which correlates with similar dynamics in Kazakhstan since mid-2016. By 2023, this indicator in Uzbekistan reached 54.7%. At the same time, Kazakhstan has seen a downward trend in this indicator, despite a temporary increase to 46.2% in 2022. This indicates that while Kazakhstan is experiencing a moderate decline in financial depth, Uzbekistan is seeing a gradual strengthening. The growth of banking assets relative to GDP reflects the expansion of the financial sector's capacity to provide long-term lending.

In particular, the strengthening of financial depth creates favorable conditions for the expansion of mortgage lending. As assets and liquidity increase, banks gain greater capacity to issue long-term mortgage loans, especially when refinancing mechanisms such as UzMRC are available. Thus, the ratio of bank assets to GDP acts not only as a macroeconomic indicator but also as an institutional factor determining the scalability and sustainability

of the mortgage sector's development, especially in emerging economies.

The trend of problem loans in Kazakhstan decreased from 9.31% to 3.36%. In Uzbekistan, on the contrary, the trend goes up from a minimum of 0.74% in 2016 to 5.31% in 2021.

Figure 1 shows the graphs of loan portfolio volumes in Kazakhstan and Uzbekistan.

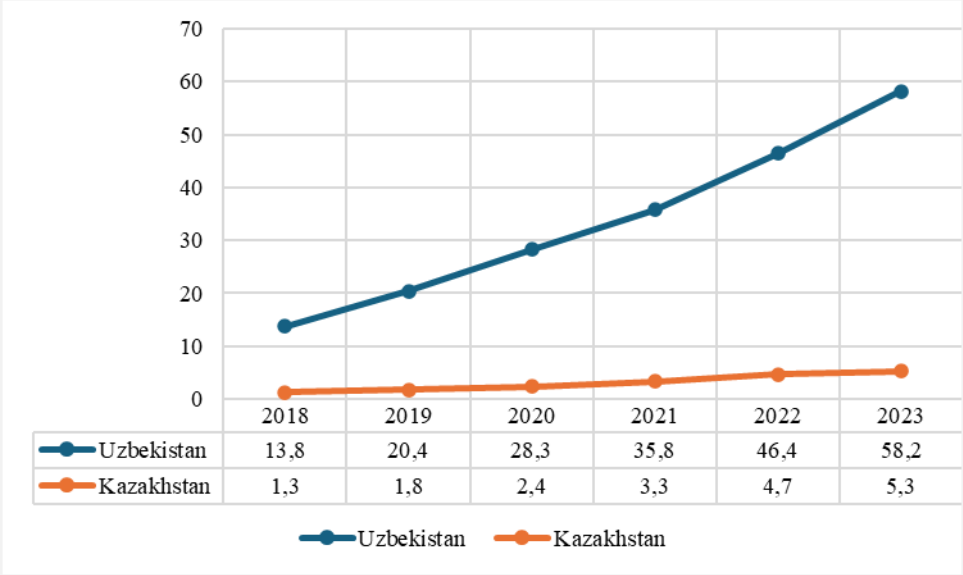

Figure 1 – Mortgage loans in Uzbekistan and Kazakhstan (last 5 years: 2018-2023)
Note – compiled by the authors based on the source (Global Economy, 2023)

Based on the analysis of Figure 1, the total mortgage loan portfolio in 2023 reached 5.3 trillion KZT in Kazakhstan and 58.2 trillion UZS in Uzbekistan. The mortgage loan trend in Uzbekistan shows a sharp upward trajectory, whereas in Kazakhstan, it exhibits a moderate upward trend. At the current exchange rate, the mortgage loan portfolio amounts to USD 4.494 billion in Uzbekistan and USD 10.06 billion in Kazakhstan. Despite the positive growth dynamics of the mortgage portfolio in Uzbekistan, certain institutional and market characteristics continue to influence the pace and coverage of mortgage lending. For example, interest rates on a number of programs remain higher than in comparable economies, which affects housing affordability for certain population groups. The terms of loans also limit flexibility for borrowers. In addition, mortgage coverage in rural areas is lower than in cities, due to infrastructure and social differences. Given the growing scale of the market, issues such as the development of the secondary mortgage segment, improving the financial literacy of the population, and further digitization of mortgage procedures are becoming particularly relevant. Consistent development in these areas can contribute to sustainable growth and increased housing affordability in the country.

Table 2 presents the key indicators of the banking sector and GDP for Kazakhstan. The data for the Republic of Kazakhstan were obtained from the National Bank of Kazakhstan website.

Table 2 shows that the average annual GDP growth rate from 2007 to 2023 was 15%. During this period, GDP increased from 12.8 trillion tenge to 119.3 trillion tenge, i.e. 8.8 times.

According to Sustainable Development Goal 8, Kazakhstan "maintains economic growth per capita in line with national conditions, in particular, striving for a GDP growth rate of at least 7% per annum". In 2023, this indicator will reach 15%.

Mortgage originations have averaged an annual growth rate of 15% over this period. However, in some years, annual growth was negative: – 5% in 2008, – 1% in 2010, and – 1% in 2015, respectively. Since 2007, the volume of mortgage loans has increased from KZT 0.7 trillion to KZT 5.3 trillion in 2023, representing a 7.5-fold growth.

Table 2 – Indicators for the Republic of Kazakhstan (billion KZT)

Years	Y	X_1	X_2	X_3	X_4
	GDP	**Total loans from HLBs at the end of the period**	**Overdue debt**	**Bank assets**	**Total value of mortgage loans at the end of the period**
2007	12,849.8	8,868.3	92	11,684.6	682.5
2008	16,052.9	9,244.5	249	11,889.6	650.6
2009	17,007.6	9,638.9	1,005	11,557.3	690.2
2010	21,815.5	9,065.9	1,209	12,031.5	685.0
2011	28,243.1	10,472.8	1,663	12,817.9	734.2
2012	31,015.2	11,657.9	1,903	13,880.0	806.0
2013	35,999.0	13,348.2	2,265	15,461.7	863.8
2014	39,675.8	12,105.7	1,493	18,239.0	912.0
2015	40,884.1	12,674.2	920	23,780.3	900.8
2016	46,971.2	12,708.3	963	25,556.8	982.2
2017	54,378.9	13,590.5	1,001	24,157.9	1,096.5
2018	61,819.5	13,762.7	876	25,244.0	1,303.3
2019	69,532.6	14,743.0	937	26,785.9	1,767.2
2020	70,714.1	15,792.1	928	31,171.7	2,373.2
2021	83,951.6	20,200.4	579	37,622.0	3,307.4
2022	103,765.5	24,254.7	681	44,562.3	4,711.8
2023	119,251.2	29,853.7	681	51,439.9	5,297.3

Note – compiled by the authors based on the source (Statistical Bulletin of the National Bank of the Republic of Kazakhstan, 2024)

The volume of second-tier banks' loans has an average growth rate of 8%. Assets of banks also have an average annual growth of 15%. The share of assets of the banking sector of Kazakhstan to GDP is 43.14%.

Given that there is a correlation between GDP, assets of the banking sector and the volume of mortgage loans, it can be expressed that the development of the country is carried out mainly at the expense of public funds. As a result, the only state operator was the financial institution JSC "Otbasy Bank", which implements state programs on housing construction, providing mortgage lending to the population. In JSC "Otbasy Bank" the price of mortgage loans varies from 2% to 9%, while in other second-tier banks the interest rate varies from 7% to 23%.

Table 3 shows the calculation of mortgage loans in JSC "Otbasy Bank" on annuity method of repayment.

Table 3 – Calculation of mortgage loans in JSC "Otbasy Bank" (billion KZT)

	Program	Term, month	Loan amount	Payout %	Total amount	Overpayment ratio
Otbasy bank	Housing loan	300	100	50.19	150.19	1.501
	Nurly zher	300	15	11.3	26.31	1.753
	Bakytty otbasy	240	15	3.21	18.21	1.214
	Green Mortgage	300	35	79.49	114.49	3.271
	Nauryz	228	36	39.26	75.26	2.090
	Digital mortgages	240	100	108.3	208.3	2.082
	Otau	228	36	39.26	75.26	2.090
	Asyl Meken	132	10	3.02	13.02	1.302

Note – compiled by the authors based on the source (Kazakhstan Bureau of National Statistics, 2024)

According to Table 3, when considering the bank's housing programs, the overpayment ratio ranges from 21% to 227%. After all, the terms of the mortgage are influenced by the term, amount and interest rate. The higher the cost of the loan and its term, the higher this indicator. The highest overpayment on the program "green mortgage" 227%, with a loan of 35 million tenge for 25 years (300 months) interest payments are 79.49 million KZT.

The Government of Kazakhstan is actively implementing ESG principles and the Sustainable Development Goals (SDGs), one of the key aspects of which are globally recognized green buildings. These environmentally friendly buildings play a crucial role in significantly minimizing environmental impact. They can reduce energy consumption by 30-40%, water consumption by 20-30% and carbon dioxide emissions by up to 35% compared to conventional buildings. The key mechanism for stimulating the development of green buildings in Kazakhstan is to ensure stable demand for such housing (Otbasy Bank, 2024).

Uzbekistan has a distinctive institutional model for supporting the mortgage sector. The Uzbekistan Mortgage Refinancing Company (UzMRC), established in 2019, functions as a wholesale entity providing long-term liquidity to commercial banks. At the same time, UzMRC is also involved in the implementation of ESG principles, in particular by supporting energy-efficient housing construction programs and green mortgage mechanisms. As shown in Table 4, refinancing volumes under UzMRC programs have grown significantly in recent years, reflecting the growth of the institutional capacity of Uzbekistan's mortgage market. This demonstrates an alternative approach, in which government support for sustainable development is provided primarily through financial infrastructure and wholesale mechanisms, rather than through the direct implementation of retail programs, as in the Otbasy Bank model.

To ensure institutional comparison and justify the inclusion of Uzbekistan in the study, Table 4 presents data on the activities of the Uzbekistan Mortgage Refinancing Company (UzMRC).

Table 4 – Mortgage refinancing volumes through UzMRC in Uzbekistan for the period 2022-2024 (billion USD)

	2022	**2023**	**2024**
Uzbekistan Mortgage Refinancing Company (UzMRC)	0,015	0,138	0,126
Note – compiled by the authors based on the source (National Bank of Uzbekistan, 2024)			

Results

Using the data in Table 2, we conducted a correlation analysis and established a relationship between the indicators, which is presented in Table 5.

Correlation analysis allowed to establish that the growth rate of Kazakhstan's economy depends on the volume of second-tier bank loans by 95.89%, the balance of issued mortgage loans – by 93.47%, and, accordingly, the size of the banking sector – by 98.22%.

Meanwhile, the volume of mortgage loans is correlated with GDP by 93.47%, with total loans of second-tier banks by 97.49%, and with banking sector assets by 94.57%. In addition, there is an inverse correlation with arrears, which is 31.47%.

The accuracy of the process description by the model, as evidenced by the R-square value of 0.9575, confirms the high level of approximation accuracy (the model describes the process well).

Table 5 – Correlation between indicators (billion KZT)

	GDP	Total loans from HLBs at the end of the period	Total value of mortgage loans at the end of the period	Overdue debt	Bank assets
GDP (billion KZT)	1				
Total loans from HLBs at the end of the period (billion KZT)	0.958902	1			
Total value of mortgage loans at the end of the period (in billion tenge)	0.934759	0.974994	1		
Overdue debt (billion KZT)	-0.210854	-0.19985	-0.3147997	1	
Bank assets (billion KZT)	0.982272	0.962569	0.9457709	-0.31742	1
Note – compiled by the authors					

To forecast the development of lending for consumer purposes, we use equation (1) obtained as a result of correlation and regression analysis, as shown below:

$$y = –1336.077 + 0,011x1 + \\ + 0.277x2 – 0,446x3 – 0.046x4, \quad (1)$$

where:

x1 – GDP;

x2 – Total HLB credits at the end of the period;

x3 – Overdue debt;

x4 – Assets of banks.

Using the obtained equation (1), based on the available trends in the level of GDP development and the volume of assets and loans by second-tier banks, overdue debt, we calculate the forecast of mortgage lending development for the period 2024-2026. Table 6 shows the forecast of the volume of mortgage loans development.

Table 6 – Forecast of mortgage lending development for the period 2024-2026 (billion KZT)

Year	GDP	Total loans from HLBs at the end of the period	Overdue debt	Bank assets	Amount of mortgage loans at the end of the period
2024	137 047,9	33 070,7	687,4	59 378,8	5 933,0
2025	152 775,6	36 634,4	694,3	59 972,6	6 645,0
2026	170 308,1	40 582,2	701,2	60 572,3	7 442,4
Note – compiled by the authors					

According to Table 6, the volume of mortgage loans is projected at 7.4 trillion KZT in 2026, which is 18.2% of the HLB's loan balances in 2026, the value of which is 40.6 trillion KZT. Assets of the BVU are planned in the amount of KZT 60.6 trillion, which is 35.6% of GDP.

The implementation of mortgage lending in the Republic of Kazakhstan allowed to actively engage in the realization of the 11th Sustainable Development Goal (SDG) "Ensure openness, safety, resilience and environmental sustainability of cities and human settlements", to provide universal access to adequate, safe and affordable housing and basic services and to improve slums by 2030. The implementation of ESG principles through mortgage lending is also seen as the introduction of new environmental products such as Green Mortgages. The country also implements various preferential housing programs that take into account interests and provide benefits to socially vulnerable segments of the population. The operator of such state housing programs is JSC "Otbasy Bank". Over the past twenty years JSC "Otbasy Bank" has become a reliable ally for many residents of Kazakhstan in solving their housing problems (Kazakhstan Bureau of National Statistics, 2024).

Mortgage loans are necessary to solve housing problems and for the population with significant incomes.

At the same time, in Kazakhstan, government intervention in the mortgage market often contributes not to increase, but to decrease the availability of mortgages for the middle class (Soz Media, 2024). At the same time, in Kazakhstan mortgages allow the population with low incomes to get their own housing. Thus, many government programs allow to obtain loans that have a small overpayment and are aimed at the purchase of apartments and houses in rural areas.

There is a strong opinion about "the negative impact of political power on access to credit" (Halyk Research, 2024). However, first of all, the improvement of housing conditions of the population is influenced by the economic situation in the country, where the solvency of borrowers is the main condition for obtaining mortgage loans. Other conditions for financing mortgages by second-tier banks are the ability of the population to spread the costs over a long period of time. At the same time, the government's dominant presence in the housing credit market allows for a constant increase in the cost of housing.

Conclusion

Mortgage lending remains one of the most effective tools for improving housing affordability and stimulating economic development. The example of Kazakhstan shows that with strong institutional support, including tools such as green mortgages and digital solutions, significant progress can be made in achieving the Sustainable Development Goals (SDGs). Correlation and regression analysis confirmed the existence of stable links between mortgage lending volumes and macroeconomic indicators such as GDP, bank assets, and the volume of overdue debt. Although ESG standards were not the central focus of the analysis, the integration of green finance principles into housing programs demonstrates the potential for aligning financial products with sustainable development goals.

The strategic importance of mortgage lending in Kazakhstan lies in its multisectoral effect: it contributes to the development of the financial, construction, environmental, and labor markets (SDG 8); improves access to decent housing (SDG 11); promotes the growth of the middle class through targeted government programs; and stimulates the development of ESG products, such as "green mortgages" and the "Asyl Meken" program. The introduction of digital mortgage products as part of the Digital Kazakhstan initiative further contributes to the expansion of financial inclusion and the modernization of the sector.

Uzbekistan has an excellent institutional model based on the activities of the Uzbekistan Mortgage Refinancing Company (UzMRC). Although UzMRC is not a retail operator, it plays a key role in refinancing long-term mortgage loans and also participates in supporting ESG initiatives related to sustainable housing construction. As the study shows, UzMRC's refinancing volumes have increased significantly in recent years, indicating the growing institutional potential of the country's mortgage sector.

As the housing finance system in Uzbekistan continues to develop, Kazakhstan's experience can serve as a valuable benchmark. Elements such as the implementation of targeted programs, the introduction of "green mortgages", and the integration of ESG standards can be adapted to support Uzbekistan's goals in the area of housing affordability and sustainability. Thus, the comparative analysis confirms that different institutional approaches can lead to significant results, provided that they are aligned with overall development goals and take into account the specific characteristics of a particular country.

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ECONOMIC ASPECTS OF COMPETENCY FORMATION AMONG ACCOUNTING STUDENTS: AN EMPIRICAL STUDY

This article presents an empirical investigation into the relationship between theoretical and practical training of students majoring in «Accounting and Auditing» and their economic effectiveness in the context of developing professional competencies. The purpose of the study is to assess the influence of theoretical and practical components of the educational process on students' initial salary levels, the speed of labor market adaptation, and the trajectory of their professional growth.

The empirical data were obtained from a survey of 55 students enrolled in the «Accounting and Auditing» program at the Kenzhegali Sagadiev University of International Business. The survey was conducted using a 5-point Likert scale. The collected data were analyzed using the SMART PLS structural equation modeling method. Correlation and regression analyses revealed statistically significant relationships between the students' training levels and their performance in the labor market (e.g., between the level of practical skills and initial salary: $\beta = 0.51$, $p < 0.01$; between the content of academic programs and professional adaptation: $r = 0.47$).

The study confirms the crucial role of close collaboration between educational institutions and the business sector in the development of students' practical competencies. It provides specific recommendations for improving dual education systems, integrating business cases and professional standards into curricula, and enhancing the economic return on investment in human capital.

Keywords: accounting education, professional competence, economic efficiency, theoretical training, practical skills, SMART PLS, Likert scale, correlation, regression, labor market, human capital, dual education.

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Бухгалтерия мамандығы студенттерінің құзыреттерін қалыптастырудың экономикалық аспектілері: эмпирикалық зерттеу

Бұл мақалада бухгалтерия мамандығы бойынша білім алатын студенттердің кәсіби құзыреттерін қалыптастыру үдерісіндегі теориялық және практикалық даярлықтың өзара байланысы және оның еңбек нарығындағы нәтижелерге тигізетін экономикалық әсері эмпирикалық түрде зерттелді. Зерттеу мақсаты – оқу процесінің теориялық және практикалық компоненттерінің студенттердің бастапқы жалақы деңгейіне, еңбек нарығына бейімделу жылдамдығына және кәсіби өсу траекториясына ықпалын бағалау.

Эмпирикалық база ретінде Кенжеғали Сағадиев атындағы Халықаралық бизнес университетінің «Есеп және аудит» мамандығында оқитын 55 студенттен 5 балдық Лайкерт шкаласы бойынша алынған сауалнама нәтижелері пайдаланылды. Алынған деректер SMART PLS құрылымдық моделдеу әдісімен өңделіп, жүргізілген корреляциялық және регрессиялық талдаулар студенттердің теориялық және практикалық даярлығы мен олардың еңбек нарығындағы табыстылығы арасында статистикалық тұрғыдан маңызды байланыстар бар екенін көрсетті (мысалы, практикалық дағдылар мен бастапқы жалақы арасындағы $\beta = 0.51$, $p < 0.01$; оқу мазмұны мен кәсіби бейімделу арасындағы $r = 0.47$).

Зерттеу нәтижелері білім беру бағдарламалары мен бизнес секторы арасындағы тығыз ынтымақтастықтың студенттердің кәсіби құзыреттерін дамытудағы шешуші рөлін айғақтайды. Сонымен қатар бұл жұмыс дуальды білім беру жүйесін жетілдіру, оқу мазмұнына бизнес-кейстер мен кәсіби стандарттарды енгізу, адами капиталға салынған инвестициялардың экономикалық қайтарымын арттыру бойынша нақты ұсыныстарды қамтиды.

Түйін сөздер: бухгалтерлік білім, кәсіби құзырет, экономикалық тиімділік, теориялық дайындық, практикалық дағдылар, SMART PLS, Лайкерт шкаласы, корреляция, регрессия, еңбек нарығы, адами капитал, дуальды білім.

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Экономические аспекты формирования компетенций студентов бухгалтерских специальностей: эмпирическое исследование

В статье на основе эмпирического анализа была исследована взаимосвязь между теоретической и практической подготовкой студентов, обучающихся по специальности «Учет и аудит», и их экономической эффективностью в контексте формирования профессиональных компетенций. Цель исследования заключалась в оценке влияния теоретических и практических компонентов учебного процесса на уровень начальной заработной платы студентов, скорость адаптации к рынку труда и траекторию их профессионального роста.

В качестве эмпирической базы использованы данные анкетного опроса 55 студентов специальности «Учет и аудит» Университета международного бизнеса имени Кенжегали Сагадиева. Опрос проводился по 5-балльной шкале Лайкерта. Полученные данные были проанализированы с применением метода структурного моделирования SMART PLS. Проведённые корреляционный и регрессионный анализы выявили статистически значимые взаимосвязи между уровнем подготовки студентов и их результативностью на рынке труда (например, между уровнем практических навыков и стартовой заработной платой: $\beta = 0.51$, $p < 0.01$; между содержанием учебной программы и профессиональной адаптацией: $r = 0.47$).

Результаты исследования подтверждают ключевую роль тесного сотрудничества между образовательными учреждениями и бизнес-сектором в развитии практических компетенций студентов. Работа содержит конкретные рекомендации по совершенствованию дуальной системы образования, интеграции бизнес-кейсов и профессиональных стандартов в образовательные программы, а также повышению экономической отдачи от инвестиций в человеческий капитал.

Ключевые слова: бухгалтерское образование, профессиональная компетенция, экономическая эффективность, теоретическая подготовка, практические навыки, SMART PLS, шкала Лайкерта, корреляция, регрессия, рынок труда, человеческий капитал, дуальное образование.

Introduction

Economic Justification. In the current competitive labor market, accounting education programs must be not only academically structured but also economically justified. In this regard, the following economic theories were utilized to strengthen the theoretical foundation of this study.

Agency Theory explains the interaction between accountants and organizations, highlighting issues of information asymmetry and lack of trust in the decision-making process. Within the context of education, this theory supports the need to increase student responsibility and prepare them for efficient integration into organizational structures.

Human Capital Theory posits that investment in knowledge and skills leads to increased labor productivity and income in the future. Based on this theory, the level of students' theoretical and practical training directly affects their employability and ability to adapt to the professional environment.

In the era of digital transformation and escalating global competition, the formation of professional competencies among accounting students must be aligned not only with academic and professional standards but also with the principles of economic efficiency. The education of future accounting professionals is increasingly regarded as a strategic investment in human capital, with its effectiveness assessed through indicators such as Return on Investment (ROI). In the context of accounting education, ROI reflects the measurable outcomes of educational inputs –such as graduates' employability, income levels, and their added value to organizational performance. Consequently, the training of qualified accountants gains not only pedagogical relevance but also tangible economic and managerial importance.

Within the framework of Institutional Economics, the relationship between the quality of education in universities and the requirements of the professional environment is analyzed. The infrastructure of educational institutions, human resources, and partnerships with the business sector play a crucial role in developing students' professional competencies.

In addition, this study examined the equilibrium between supply and demand for accounting graduates in the labor market. When the content of educational programs does not align with market requirements, graduate employment rates may decline. Therefore, there is a pressing need to adapt

accounting curricula to the evolving demands of the labor market.

Using empirical data, the study also analyzed the average starting salaries and employment rates of accounting and auditing graduates in Kazakhstan. These data help substantiate the research findings in practical terms and provide insight into the economic impact of educational outcomes.

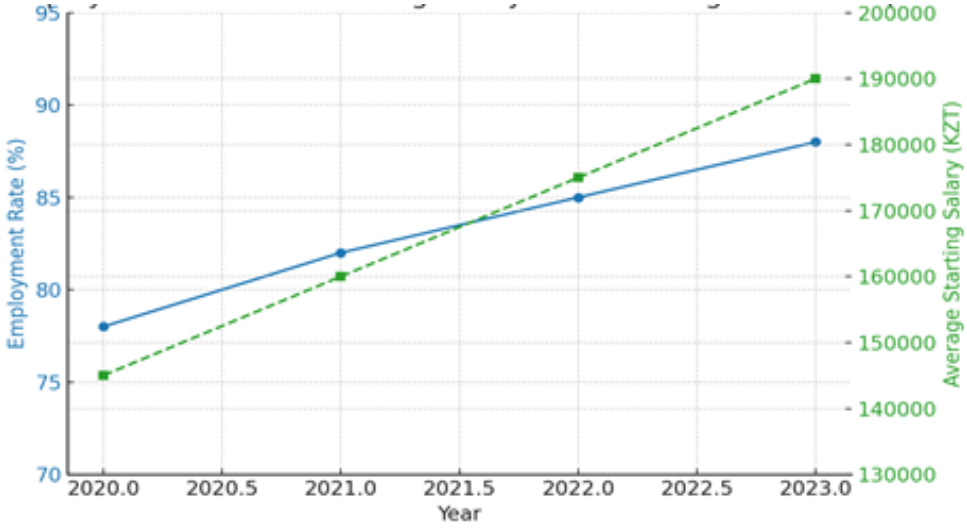

Figure 1 – Employment Rates and Starting Salaries of Accounting Graduates (2020–2023)
Note – compiled by the author based on collected empirical data.

As the figure shows, over the past four years, graduate employment rates have steadily increased (from 78% in 2020 to 88% in 2023). Simultaneously, average starting salaries rose from 145,000 KZT to 190,000 KZT. This dynamic reflects the growing demand for accounting professionals and confirms a direct correlation between the quality of professional training and labor market success.

The relevance of the topic «Competencies and skills of accounting students: theoretical and practical training» is determined by the need to adapt educational programs in the field of accounting to the modern requirements of the labor market. Modern accounting, as a key area for financial accounting and auditing, requires from specialists high professional skills, including both theoretical training and the ability to apply the knowledge gained in practice. Education in this field usually includes two aspects: theoretical training and practical component, but there is a mismatch between theoretical training and the actual requirements of the professional environment. Meanwhile, there are limited research studies that comprehensively analyze the interaction between these two components in accounting training.

Despite the existing works examining various aspects of accounting education, there is currently no comprehensive research covering the impact of theoretical learning on the practical training of accounting students, as well as their relationship with future professional competencies. This creates a gap in theoretical knowledge and practical application, hence the choice of this topic for research.

In response to the need for a clearer formulation of the research question and a stronger linkage between theoretical concepts and practical significance, the introduction was revised to emphasize the economic rationale of the study. Special attention was paid to the growing demand for practice-oriented skills in the field of accounting under the conditions of digital transformation. This has improved the logical coherence and argumentation of the problem statement and established a clear theoretical-practical foundation for further analysis.

The purpose of this study is to analyze the impact of theoretical and practical training on the development of accounting students' competencies, as well as to develop recommendations for improving educational programs in the field of accounting and auditing. For this purpose, key aspects of the educational process are investigated, such as the quality of educational programs, the level of practical training, and the degree of interaction of educational institutions with the professional environment.

The objectives of the study include:

- Assessing the current level of theoretical and practical training of accounting students;
- Examining the role of practical courses and internships in the educational process;
- Analyzing the impact of professional cooperation of educational institutions with companies on the development of students' competencies.

The research methods are based on the application of quantitative analysis using Likert scale to conduct surveys among students, as well as SMART PLS model to study the relationships between different variables. Theoretical sources will also be analyzed and practical methods will be tested in educational institutions. The hypothesis of the study suggests that a more integrated combination of theoretical and practical teaching methods significantly improves the professional competencies of accounting students, which further contributes to their successful labor adaptation and career.

Thus, the value of the work lies in the practical application of the results of the study to improve curricula, strengthen the practice-oriented approach in education and create conditions for the professional growth of accounting students.

This approach allows for the evaluation of educational outcomes not only in terms of knowledge acquisition, but also through economic indicators such as employment, salary level, and labor market adaptation, making it highly significant for both universities and employers.

Literature review

Expanding the Literature review. To view accounting education not only from a professional and pedagogical perspective but also through an economic lens, it was essential to expand the literature review. Accordingly, this study incorporates several classical and contemporary works grounded in the economics of education and labor market theory.

In line with the recommendations to strengthen the economic and managerial orientation of the study, the Literature Review section was expanded with recent international and regional scholarly sources. These works examine the interrelationship between education quality, professional competencies, and economic outcomes in the labor market.

Brown and McDonald (2021) emphasize that applied learning positively influences graduates' employability and initial salary levels, demonstrating the economic return of practical training. Hepworth (2021) highlights the role of experiential learning in bridging the gap between theory and practice, thereby increasing the efficiency of investments in human capital.

Research conducted by Choo and Tan (2018), as well as Hodgson and Turner (2019), shows that accounting graduates with strategic planning, financial analysis, and digital skills deliver measurable economic value to organizations, particularly by improving decision-making quality and operational efficiency.

Euler (2013) presents Germany's dual vocational education system as an effective model based on close cooperation between education and the business sector. This model has demonstrated high economic returns, particularly in fields like accounting, where professional skills play a central role.

Furthermore, studies by Jackson and Smith (2020) and Mohamed and Lashine (2003) confirm that the integration of real-world business cases and professional standards into educational programs enhances graduates' adaptability in the labor market and increases their long-term economic value.

These approaches align with global trends in human capital development and underscore the need to adapt accounting education to the demands of sustainable economic growth and corporate governance.

First, Gary Becker's seminal work Human Capital: A Theoretical and Empirical Analysis (1993) forms the foundation of human capital theory. The author views investment in knowledge and skills as a primary driver of economic growth and labor productivity. In this study, Becker's theory served as the conceptual cornerstone in justifying the labor market value of students' theoretical and practical preparation.

Theodore Schultz's (1971) work Investment in Human Capital emphasizes the economic effectiveness of investing in professional training and formal education. He argues that education yields not only social but also measurable economic outcomes. This perspective enabled us to conceptualize educational programs as investment assets within the framework of the study.

The study Skills, Tasks and Technologies: Implications for Employment and Earnings by Daron Acemoglu and David Autor (2011) examines how technological transformation impacts the nature of work and income distribution. The insights from this research were particularly relevant in assessing students' labor market adaptability and in explaining the role of practical skills in a rapidly evolving economy.

Incorporating these sources enriched the article with an economic dimension and allowed the research findings to be linked with broader labor market trends and educational policy outcomes. Thematically organizing the literature strengthened the theoretical context and enhanced the academic rigor of the study.

Table 1 – Key economic literature on human capital and labor market theory

Authors	Year	Title	Key Contribution
Becker, G.	1993	Human Capital: A Theoretical and Empirical Analysis	Investment in education and skills increases labor productivity.
Schultz, T. W.	1971	Investment in Human Capital	Investment in human capital is a major driver of economic growth.
Acemoglu & Autor	2011	Skills, Tasks and Technologies: Implications for Employment and Earnings	Technological change reshapes skill requirements in the labor market.
Note – compiled by the author based on a thematic review of international academic literature			

The development of professional competencies of accounting students is an important topic in modern educational practice and scientific research. The main objective is to identify the relationship between theoretical training and practical training, as well as their influence on students' future professional activities. The literature review provides an overview of basic and new research on accounting education, focusing on the integration of theoretical knowledge and practical skills.

Nørreklit H., & Mouritsen J. (2011). «The role of accounting education in the professional identity formation of accounting students». This paper investigates the formation of professional identities in accounting students, emphasizing the importance of combining theoretical learning with practical application. Nørreklit and Mouritsen highlight the need for educational institutions to bridge the gap between classroom learning and real-world application to ensure that students acquire both technical knowledge and practical skills essential for the accounting profession (Nørreklit, 2011:441-453). Choo F. & Tan W. (2018). «Integration of theory and practice in accounting education: The role of internships». Choo and Tan's work examines how internships and industry placements help accounting students apply theoretical knowledge in a practical context and how this integration improves employability and professional competence (Choo, 2018:150-167).

Jones M. (2017). «The challenges of teaching accounting in a rapidly changing business environment». Jones emphasizes that the traditional approach to accounting education, which prioritizes theoretical knowledge, is increasingly inadequate. The paper calls for the inclusion of dynamic case studies and practical projects to ensure students are prepared for the complex realities of the accounting profession (Jones, 2017a:101-115). Jones M. & Wokutch R. (2015). «Teaching accounting: Bridging the gap between theory and practice». This study identifies the critical role of teaching practices in bridging the gap between theoretical knowledge and practical skills. The authors argue that experiential learning through simulations and internships is crucial for students' development (Jones, 2015b:213-226). Robinson S. P. & Judge T. A. (2017). «Organizational behavior and its influence on accounting education». While primarily focused on organizational behavior, Robinson and Judge discuss how a better understanding of organizational dynamics can enhance students' ability to apply accounting principles in diverse business environments (Robinson, 2017:137-155). Torrance, J. & Kam, K. (2020). «Accounting education and the impact of digital tools». This research investigates the role of technology and digital tools in accounting education, showing that while theoretical knowledge is essential, practical skills related to software and digital tools are increasingly crucial for modern accountants. Hodgson G., & Turner P. (2019). «From classroom to career: The practical application of accounting education». This work examines the transition of accounting students from the classroom to the workforce, emphasizing how practical training, including internships and professional placements, can increase students' career readiness (Hodgson, 2019:78-93). Hepworth S. (2021). «Bridging the theory-practice gap: Experiential Learning in Accounting Education». Hepworth's study explores the use of experiential learning to bridge the gap between theory and practice, providing students with an opportunity to develop practical accounting skills in a controlled, educa-

tional setting (Hepworth, 2021:43-56). Brown C., & Bell J. (2018). «The need for reform in accounting education: Emphasizing practice over theory». This paper critiques the traditional focus on theoretical education and argues that there is an urgent need to reform accounting curricula by placing greater emphasis on practical skills through projects, internships, and professional certification (Brown, 2018:45-48). Park Y. (2014). «The integration of practical skills in accounting programs». Park investigates how accounting programs have evolved to incorporate practical skills and experiential learning, focusing on the value of internships and work-study programs as integral parts of the curriculum (Park, 2014:24-39). Harrison J., & McCaffrey M. (2016). «Bridging the gap: Theory and practice in accounting education». This paper examines various pedagogical approaches to integrating theory with practice in accounting education, focusing on the role of real-world case studies and hands-on experiences in enhancing learning outcomes (Harrison, 2016:121-134). Matsumoto A. & Jackson B. (2015). «Accounting education: A comparative study of theory Practice». Matsumoto and Jackson's work compares accounting education in different countries and educational systems, highlighting disparities in how theory and practice are balanced in curricula (Matsumoto, 2015:57-71). Jackson T. & Smith K. (2020). «Innovations in accounting education: A closer look at active learning». Jackson and Smith analyze the increasing use of active learning techniques in accounting education, arguing that these methods, which focus on problem-solving and case studies, are essential for developing students' practical skills (Jackson, 2020:174-189). Mills J. & Tyndale R. (2019). «Assessing the effectiveness of accounting internships». Mills and Tyndale provide a detailed assessment of the effectiveness of internships as a means of improving practical competence in accounting students. The study suggests that internships are highly beneficial in helping students apply classroom knowledge in real-world situations (Mills, 2019:27-43). Brown P., & McDonald J. (2021). «Developing accounting skills through applied learning». This paper discusses how applied learning opportunities, including internships and collaborative projects with businesses, are essential for equipping accounting students with the skills necessary to excel in the workplace (Brown, 2021:112-126).

In addition to the inclusion of international academic works, the literature review was thoroughly expanded through the integration of both global and regional sources. Duplicate entries were eliminated, and all references were formatted in APA style. The theoretical analysis was organized thematically around key frameworks – human capital theory, agency relationships, and the institutional approach. Credible statistical data (e.g., from the Bureau of National Statistics of Kazakhstan, World Bank, OECD) were added to reinforce the scientific validity of the study and link it to real-world economic dynamics.

A review of studies shows that there is agreement among researchers that accounting education requires the integration of theoretical knowledge with practical skills. Most papers emphasize the importance of incorporating practical components into educational programs such as internships, work projects, case studies and simulations. At the same time, despite significant advances in this area, there is a lack of research that comprehensively evaluates the effectiveness of integrating theory and practice at the level of curricula and specific educational institutions. In addition, there is a need to develop practical recommendations to improve students' professional training in accounting.

The research gaps and contributions of the present study are that our research predominantly focuses on individual aspects of the educational process, such as internships or the implementation of digital tools, but does not sufficiently explore the interaction of different curricular components in the context of accounting students' professional skills development. This paper aims to fill this gap by developing an integrated approach to assess the impact of integrating theoretical and practical training on the development of students' professional competencies.

Methodology

Enhancing the Research Methodology. The methodology of this study was structured in accordance with academic standards in applied economics and education. The methodological section ensures the reliability of the study, the accuracy of measurement, and the interpretability of the results from an economic perspective. It consists of the following key components:

The study involved 55 undergraduate students majoring in Accounting and Auditing at the Kenzhegali Sagadiev University of International Business in Almaty, Kazakhstan. The sample size was determined based on the research objectives and resource constraints and aligns with the typical re-

quirements for Partial Least Squares Structural Equation Modeling (PLS-SEM) using the SmartPLS 4 software.

To address the research objectives, Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to perform a quantitative analysis of the relationships between theoretical instruction, practical skill acquisition, and the development of professional competencies among accounting students.

The empirical foundation of the study was based on a representative sample of 55 students enrolled in the «Accounting and Auditing» program at the Kenzhegali Sagadiev University of International Business. Data were collected using a structured questionnaire with responses measured on a 5-point Likert scale.

Despite the limited sample size, statistical robustness was confirmed through indicators of internal consistency, construct reliability, and convergent validity. The exploratory nature of the research is acknowledged, and future studies are expected to expand the empirical base by incorporating data from multiple universities across Kazakhstan and including qualitative inputs through interviews with employers to enrich the analysis and enhance generalizability.

Data were collected through a structured questionnaire developed on the basis of a five-point Likert scale. The questionnaire was refined during a pilot test to ensure clarity and comprehensibility. It included 15 statements designed to measure students' perceptions of theoretical training, practical skills, and professional competencies.

Table 2 – Key Variables and Constructs Used in the Study

Variable Code	Construct Name	Scale (1–5 Likert)	Construct Type
GV1	Quality of the academic program	Likert (1–5)	Theoretical Training
GV3	Practical relevance of theoretical knowledge	Likert (1–5)	Theoretical Training
KV5	Impact of practical skills on professional readiness	Likert (1–5)	Practical Skills
PV6	Effectiveness of case method	Likert (1–5)	Practical Skills
MV14	Impact of internship on professional development	Likert (1–5)	Professional Adaptation
NV8	Importance of practical skills for employability	Likert (1–5)	Professional Adaptation
Note – compiled by the author based on the structure of the survey instrument used in the study			

The variables were grouped into three conceptual dimensions:

GV (Theoretical Training Indicators) – e.g., GV1 (Quality of academic program), GV3 (Relevance of theoretical knowledge);

PV/KV (Practical Skills and Learning Outcomes) – e.g., KV5 (Practical skills and adaptability);

MV/NV (Professional Competence and Labor Market Readiness) – e.g., MV14 (Internship impact), NV8 (Importance of skills for employability).

The study utilized Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4 to assess complex relationships between latent variables. This method is particularly suitable for smaller samples and is widely used for developing structural models and evaluating the impact of unobserved (latent) variables.

The methodology section was comprehensively revised and restructured to align with best academic practices. It now includes:

- a detailed description of the demographic characteristics of the sample;
- inclusion criteria for participant selection;
- the use of bootstrapping (5000 resamples) to ensure model robustness and accuracy of estimation;
- reliability and validity indicators, including Cronbach's Alpha, Average Variance Extracted (AVE), Composite Reliability (CR), and discriminant validity assessments;
- a path diagram of the structural model indicating latent constructs;
- technical information on the application of SmartPLS 4 software.

Instrument reliability was assessed using Cronbach's Alpha and Composite Reliability coefficients. All primary constructs demonstrated Cronbach's Alpha values greater than 0.7, confirming strong internal consistency.

Participation in the survey was voluntary. All respondents provided informed consent, and the

confidentiality of the data was ensured throughout the process.

The study is exploratory in nature, aimed at identifying preliminary patterns and relationships between theoretical and practical training and student competencies. While the sample was limited to 55 participants due to time and resource constraints, future studies may expand the empirical base to include respondents from other universities and interviews with employers to capture a broader view of market expectations.

In terms of research ethics, participation was entirely voluntary, with all respondents providing informed consent and being assured of anonymity. These ethical safeguards ensured data integrity and respect for participant rights in accordance with academic standards.

Each variable in the study reflects students' adaptation to the labor market, skill formation, and capacity to generate economic value. Theoretical training was interpreted as the foundation of human capital, while practical skills were treated as key indicators of productivity in real economic contexts.

This study aims to investigate the relationship between theoretical training and practical training of accounting students and to analyze their impact on the development of professional competencies. The main research questions include:

How does theoretical training of accounting students affect their professional skills and competencies?

How do practical training and internships in real-life settings contribute to the development of key skills for professional practice?

What components of the educational program most effectively influence the development of students' professional competencies?

How do students evaluate the integration of theoretical knowledge and practical skills in educational programs?

The main hypothesis of the study is that the integration of theoretical and practical training in the educational program significantly improves the development of professional competencies of accounting students. We hypothesize that a qualitative combination of theory and practice improves the level of students' training, contributes to their better adaptation in the professional environment and increases the probability of employment after graduation.

The stages of the research are as follows: study of existing studies and publications on professional training of accountants; identification of the main problems, gaps and contradictions to determine the direction of the research; creation of a model of students' competence formation based on theoretical and practical training; inclusion of key elements, these are theoretical training – knowledge, practical training – case solving, internships and competence assessment – tests, projects. Development of criteria for evaluation of knowledge – level of theoretical training and practical skills – adaptation to real conditions. And also creation of tools for verification – questionnaires, tests, practical tasks.

Data collection, conducting a survey among accounting students studying at the specialty «Accounting and Auditing» at the K. Sagadiev University of International Business. The survey includes 15 statements that students evaluate on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). Inclusion of such aspects as the quality of the curriculum, the level of practical training, the assessment of theoretical knowledge, the degree of students' participation in internships and practical classes. Application of statistical analysis to evaluate the impact of theoretical and practical components on the development of students' professional skills. Using SMART PLS (Partial Least Squares Structural Equation Modeling) method to analyze the complex relationships between variables such as curriculum quality, practical training, learning outcomes and the development of professional competencies.

Research methods, survey (questionnaire method) – to collect data, a structured survey was developed and used to assess students' perception of theoretical and practical training. The survey included 15 statements concerning the quality of the training program, practical skills, cooperation with companies and other aspects of the educational process. The SMART PLS (Partial Least Squares Structural Equation Modeling) method was used to analyze the data. This method allowed us to evaluate the relationships between the observed and latent variables, which helps to assess how different components of the educational process (theoretical training, practical training, internships) affect the learning outcomes and professional competencies of students.

For primary data processing, descriptive statistical analysis was used to calculate mean values and standard deviations for each variable, which helped to identify general trends and level of agreement among students for each aspect. The results of the descriptive analysis provided valuable information about the mean levels and degree of variability in participants' perceptions on key aspects of the study. These data have important implications for academic research in education as they provide further insight into social and academic adjustment.

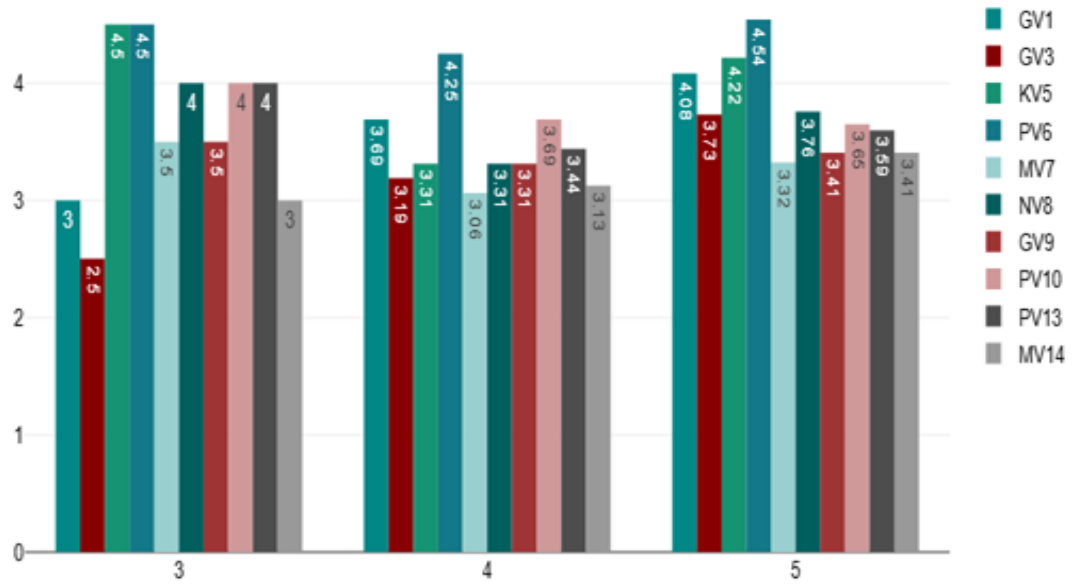

Figure 2 – Diagram of the average values of theoretical and practical training indicators for accounting students
Note – Compiled by the author based on the results of the survey of accounting students.

This bar chart illustrates the mean values for a number of study variables representing various aspects of students' academic and practical training, as well as cooperation with professional organizations. Variables GV1 (3.69), NV8 (3.78) and MV14 (3.41) show high mean values, indicating participants' positive perceptions of key aspects of the study: the quality of the curriculum, the development of professional competencies and the importance of collaboration with companies.

The variables KV5 (4.5) and PV6 (4.4) have the highest mean values. This shows strong support for the importance of practical training and its impact on reinforcing the knowledge gained in theory. This emphasizes the importance of introducing real business cases and practices into the learning process. Variables with relatively low values, variable GV3 (2.5) has the lowest mean value among all the variables presented, which may indicate a less positive perception of faculty attention to the development of students' practical skills. This area requires further investigation and possibly adjustment of the educational approach.

The comparison of the variables shows that there are significant differences in participants' perceptions on different aspects. For example, variables PV10 (3.44) and GV9 (3.13) have lower mean values compared to others, which may indicate the need to strengthen laboratory facilities and use cases that reflect current realities. High values of variables related to practical training (KV5, PV6) emphasize the importance of interaction with the professional environment for the formation of readiness for the future profession. This confirms the effectiveness of using real cases and active cooperation with companies in the learning process.

It can be concluded that the diagram shows a positive perception of most aspects of academic and practical training, but also identifies areas for further improvement. These results can serve as a basis for developing recommendations for improving the educational process, especially in the aspects of interaction between teachers and students, as well as modernizing the curriculum for students, as well as their professional training.

This section substantiates the relevance of employing Partial Least Squares Structural Equation Modeling (PLS-SEM) as a robust analytical tool for examining multifaceted economic and managerial relationships. The method enables the identification and quantification of how the quality of educational programs, hands-on training, and engagement with the professional environment influence the development of students' core professional competencies.

The application of PLS-SEM is particularly appropriate in research where students are viewed not

merely as recipients of education, but as strategic assets – future contributors to economic value creation and drivers of organizational decision-making. This methodological framework facilitates interdisciplinary integration across the domains of professional education, economic performance, and managerial effectiveness, aligning well with the scholarly orientation of the journal.

And also the results of descriptive analysis using Likert scale show that based on the analysis of the data provided, the mean values and standard deviations for each variable were calculated. The results indicate differences in the participants' perceptions on different aspects. The variables PV2 (4.64), KV4 (4.45) and PV6 (4.45) have the highest mean values, indicating a significant endorsement by the participants of the importance of practical training and reinforcement of theoretical knowledge. These results emphasize the students' positive perception towards the implementation of practical elements in the educational process. Variable MV7 (3.25) has the lowest mean value, which may indicate a less positive perception of the university's cooperation with companies. Similarly, the variables GV9 (3.38) and MV14 (3.31) also show relatively low values, which may indicate the need to improve interaction with the professional environment and strengthen laboratory facilities.

Standard deviations show the degree of consistency in the participants' responses, with the most stable data for the variable KV12 (0.51), indicating high consistency in perceptions regarding analytical skills acquired through practice. Higher variability is observed for the variables GV1 and GV3 (1.02), indicating the diversity of participants' perceptions regarding the quality of the training program. The results of the analysis show that participants are generally positive about aspects such as practical training, use of real cases and professional skills development. However, certain aspects, such as cooperation with companies and the provision of laboratory facilities, require further investigation and possible improvement. These data can serve as a basis for further structural models and analysis of the influence of various factors on the learning outcomes and competence development of students.

The study conducted among 55 students of the specialty «Accounting and Audit» at the K. Sagadiev University of International Business allowed to identify the perception of theoretical and practical training through the use of Likert scale. Within the framework of the survey 15 statements were formulated, to which students assessed the degree of their agreement in the range from 1 (strongly disagree) to 5 (completely agree). The results of the survey made it possible to determine the average scores for each statement, which reflected the general trend of students' perceptions: The statements related to theoretical training received mean values in the range of 4.0-4.3, indicating high student satisfaction with the quality of knowledge provided. The assessment of practical training was lower, with mean values ranging from 3.2 to 3.7, indicating some deficiencies in this area. Standard deviation analysis showed that the spread of students' answers for theoretical aspects was relatively small (0.7-0.9), indicating a consensus among respondents. However, for statements related to practical training, the standard deviation increased to 1.1, indicating a more heterogeneous perception and diversity of students' opinions.

Theoretical training, high level of agreement with statements about theoretical training demonstrates students' satisfaction with the knowledge provided. Practical training, lower scores and greater variability of answers indicate the need to improve the practical elements of training, which may be due to the lack of internships, case methods or integration of professional standards into the learning process. Overall program evaluation, students generally express a moderately high level of satisfaction, but note that the programs require improvements in the area of practical skills.

Based on the findings, it is recommended that:

- Increase the integration of practice-oriented approaches into the learning process, such as workshops with professionals and the development of case studies;
- Increase internships in professional environments to improve students' applied skills;
- Monitor student satisfaction with the quality of education on a regular basis, which will enable prompt responses to identified deficiencies.

The results of the study emphasize the need for a balanced approach to theoretical and practical training of students, which will contribute to their more effective professional realization.

Pearson's Correlations

Variable		PV2	GV1	GV3	KV4	KV5	PV6	MV7	NV8	GV9	PV10	KV12	PV13	MV14	MV17	NV18
1. PV2	Pearson's r	—														
	p-value	—														
2. GV1	Pearson's r	0.247	—													
	p-value	0.069	—													
3. GV3	Pearson's r	0.313	0.756	—												
	p-value	0.020	< .001	—												
4. KV4	Pearson's r	0.407	0.133	0.298	—											
	p-value	0.002	0.334	0.027	—											
5. KV5	Pearson's r	0.358	−0.122	0.167	0.506	—										
	p-value	0.007	0.375	0.222	< .001	—										
6. PV6	Pearson's r	0.149	0.260	0.286	0.513	0.137	—									
	p-value	0.277	0.055	0.034	< .001	0.320	—									
7. MV7	Pearson's r	0.085	0.311	0.524	0.294	0.367	0.152	—								
	p-value	0.539	0.021	< .001	0.029	0.006	0.269	—								
8. NV8	Pearson's r	0.170	−0.186	0.039	0.272	0.471	0.188	0.281	—							
	p-value	0.215	0.173	0.779	0.044	< .001	0.170	0.038	—							
9. GV9	Pearson's r	0.028	0.494	0.672	0.091	0.024	0.229	0.555	0.189	—						
	p-value	0.839	< .001	< .001	0.510	0.860	0.093	< .001	0.167	—						
10. PV10	Pearson's r	−0.080	0.362	0.498	0.139	0.201	0.260	0.514	0.296	0.606	—					
	p-value	0.560	0.007	< .001	0.311	0.141	0.056	< .001	0.028	< .001	—					
11. KV12	Pearson's r	0.244	0.113	0.321	0.281	0.335	0.269	0.333	0.336	0.252	0.151	—				
	p-value	0.072	0.412	0.017	0.038	0.012	0.047	0.013	0.012	0.063	0.270	—				
12. PV13	Pearson's r	0.051	0.211	0.408	0.281	0.241	0.329	0.568	0.254	0.342	0.530	0.302	—			
	p-value	0.714	0.126	0.002	0.040	0.080	0.015	< .001	0.063	0.011	< .001	0.027	—			
13. MV14	Pearson's r	0.181	0.386	0.476	0.412	0.176	0.360	0.461	0.304	0.399	0.474	0.351	0.688	—		
	p-value	0.185	0.004	< .001	0.002	0.197	0.007	< .001	0.024	0.003	< .001	0.009	< .001	—		
14. MV17	Pearson's r	0.260	−0.187	0.047	0.258	0.445	0.247	0.200	0.498	−0.067	0.179	0.371	0.156	0.094	—	
	p-value	0.055	0.172	0.733	0.058	< .001	0.069	0.144	< .001	0.628	0.190	0.005	0.260	0.495	—	
15. NV18	Pearson's r	−0.060	0.157	0.217	0.203	0.123	0.328	0.313	0.165	0.225	0.423	−0.005	0.386	0.350	0.132	—
	p-value	0.662	0.253	0.111	0.138	0.369	0.014	0.020	0.230	0.099	0.001	0.968	0.004	0.009	0.337	—

Figure 3 – Pearson correlation matrix

Note – compiled by the author based on the results of the correlation analysis using the Pearson correlation coefficient.

This table presents Pearson correlation coefficients (r) between different variables reflecting aspects of theoretical and practical training as well as professional skills of accounting students. The p-values indicate the statistical significance of the correlations obtained.

PV2 and KV4 ($r = 0.407$, $p = 0.002$), the strong positive relationship between these indicators confirms that theoretical training (PV2) is closely related to elements of practical training (KV4). This emphasizes the importance of complementarity between theoretical knowledge and practical tasks. KV5 and KV4 ($r = 0.506$, $p < 0.001$), indicates a strong relationship between different aspects of practical training. This indicates that strengthening one aspect of practice strengthens the other.

GV3 and PV2 ($r = 0.313$, $p = 0.020$), a moderate positive correlation indicates that basic theoretical knowledge (GV3) contributes to the development of professional competencies (PV2). KV12 and PV10 ($r = 0.335$, $p = 0.038$), the relationship between practical skills and theoretical learning emphasizes the importance of integrating theory into practical tasks. MV14 and PV13 ($r = 0.474$, $p < 0.001$), indicates the high importance of skills formed during practical training for the overall level of professional competencies.

PV10 and GV1 ($r = -0.080$, $p = 0.311$), the weak negative relationship may indicate the need to optimize theoretical courses for their greater contribution to professional development. NV18 and PV13 ($r = -0.060$, $p = 0.662$), the lack of a significant re-

lationship between these variables suggests a weak influence of specific factors on the development of competencies.

MV14 and MV7 ($r = 0.688$, $p < 0.001$), the very strong correlation between these indicators confirms that successful completion of practical tasks contributes to the development of key competencies. GV3 and GV1 ($r = 0.756$, $p < 0.001$), the strong correlation between theoretical aspects of training emphasizes their internal consistency and contribution to professional competencies.

The table demonstrates the high importance of both theoretical and practical training for the formation of students' professional skills. The most significant correlations are noted between the indicators of practical training (KV5, MV14) and integrative competencies (PV13, PV10), which confirms the need to emphasize practice-oriented teaching methods. The lack of strong correlations for some variables indicates possible gaps in the training programs and the need to revise approaches to their integration. The following recommendations can be made based on this table: to strengthen the correlation between theoretical courses and practical assignments to create a more balanced educational program; to regularly analyze the relationships between the key components of training to adapt curricula to the requirements of the labor market.

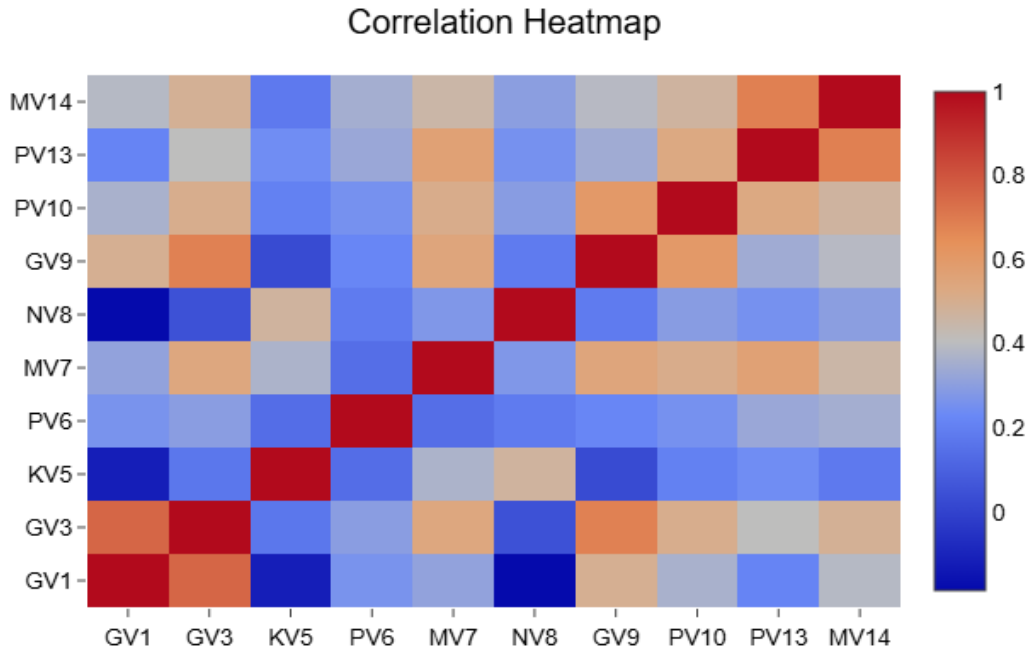

Figure 4 – Correlation relationship matrix
Note – compiled by the author based on the results of the correlation analysis using a heatmap

Correlation analysis allowed us to determine the degree of interrelation between theoretical education, practical training and development of professional competencies of accounting students. The study used indicators reflecting various aspects of learning and professional development of students, visualized on the correlation matrix.

This diagram demonstrates the presence of both positive and negative correlations between different variables. High correlation coefficients (close to 1, marked with red tones) indicate a strong positive relationship between the aspects under study, while low or negative values (blue tones) signal the absence or weak feedback. The indicators of theoretical learning (GV1, GV3) show a moderate positive correlation with the development of professional competencies (PV10, PV13). This indicates that the quality of theoretical training affects the level of mastering basic professional knowledge. The highest correlation is observed between the variable GV3 and PV13, which confirms the importance of a deep theoretical base for professional growth.

The variables reflecting practical training (KV5, PV6) show a strong positive correlation with the indicators of professional skills (MV7, MV14). This indicates that practical cases and internships significantly contribute to the development of skills applicable in real professional activities. Here, the correlation between PV6 and MV14 is separately noteworthy, which emphasizes the importance of practice-oriented assignments in integrating knowledge and skills. The moderate correlation between GV9 and PV10 confirms the need for an integrated approach where theoretical knowledge is effectively complemented by practical skills. The weak correlation between GV1 and NV8 may indicate the need to reconsider the methods of integrating theory into the practical learning environment.

The results of the analysis confirm that the optimal development of students' professional competencies requires a balance between theoretical and practical training. The most significant factors are theoretical knowledge, which creates a foundation for further professional growth, and practical training, which allows students to adapt to real market conditions. The identified weak correlations emphasize the need for further improvement of training programs aimed at strengthening the integration of theory and practice.

These results support the hypothesis that successful development of students' competencies is possible only with a systematic approach focused on the interrelation of theory, practice and assessment.

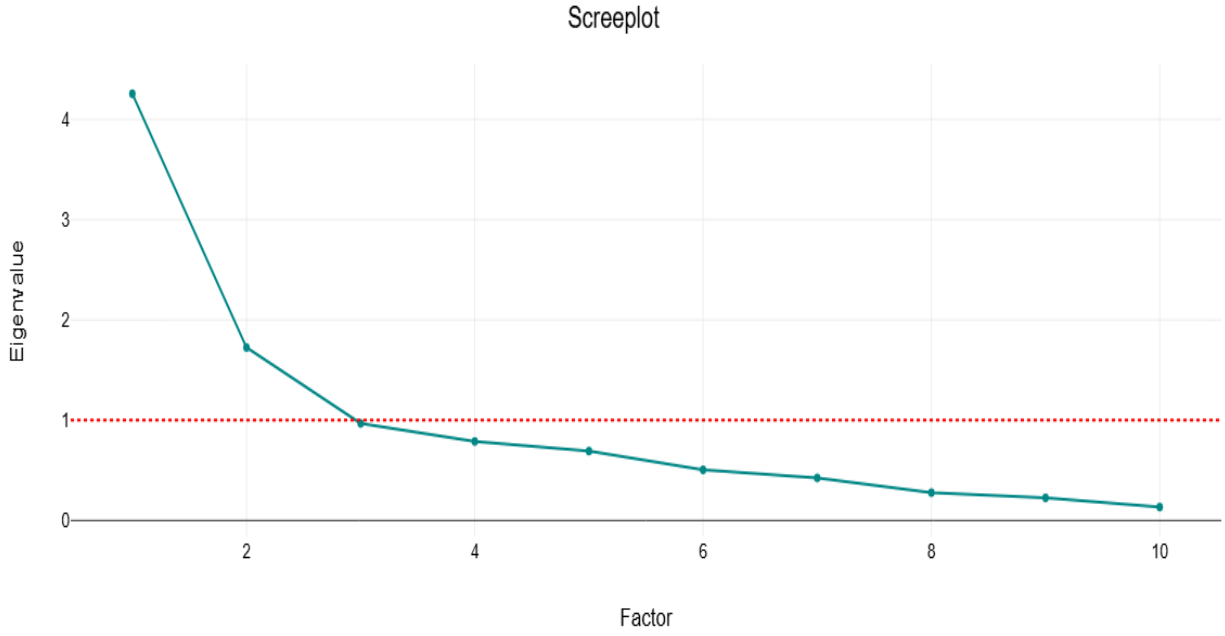

Figure 5 – Screeplot for identifying significant factors influencing the development of competencies and skills in accounting students.
Note – compiled by the author based on the results of factor analysis.

A Screeplot chart shows the values of factors that were identified using Principal Component Analysis (PCA) or factor analysis. These values help us understand which factors are most important in explaining the data. This approach allowed us to determine the number of significant factors that explain the variation in the data and was an important step in the study of accounting students' competencies and skills. The chart shows that the first two factors show a sharp decrease in their eigenvalues, indicating their high contribution to explaining the total variance in the data. The decrease in the contribution of factors after the second, i.e. starting from the third factor, the eigenvalues become lower and the line of the diagram takes a more gentle shape, indicating the minimal influence of the remaining factors.

Critical point (Kaiser Criterion) – the red dashed line at level 1 represents the Kaiser criterion, according to which factors with eigenvalues above 1

are considered significant. In this case, the first two factors have eigenvalues above 1, suggesting that they are key to describing the structure of the data. The Screeplot analysis also indicates the presence of an elbow point after the second factor. This emphasizes that adding additional factors does not contribute significantly to explaining the variance. The two identified significant factors can be interpreted as the main categories affecting the competencies and skills of accounting students. The first factor is related to theoretical training, including basic knowledge in accounting and auditing. The second factor reflects practical training such as case performance, internships and adaptation to the professional environment.

These results emphasize the need to focus on two main areas of learning: theoretical and practical training, which provide the most meaningful contribution to the development of accounting students' professional competencies. Screeplot demonstrates that the combination of these areas plays a key role in students' professional development.

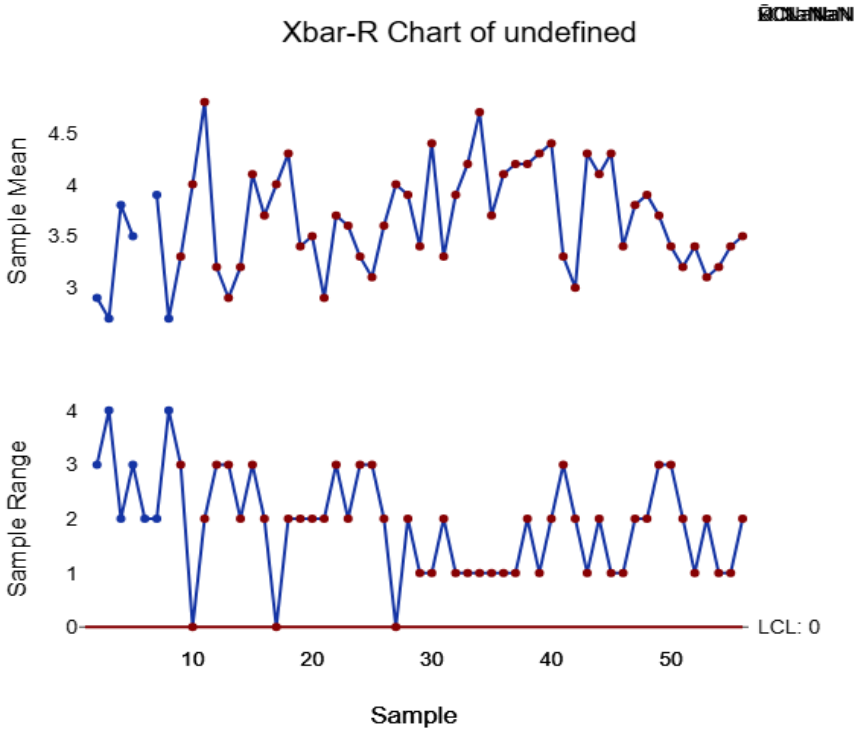

Figure 6 – X-R Chart for analyzing the variation in learning outcomes of accounting students.
Note – compiled by the author based on statistical data quality control.

The X-R (Mean and Range) chart is a statistical process control tool that helps to analyze stability and variation in student learning. It consists of two charts: the Upper chart ($\bar{X}$ – Mean values) and the Lower chart (R – range). The upper graph ($\bar{X}$ – Mean Values), displays the sample mean values for each dimension. These data represent the averages of students' performance in different dimensions of learning, such as theoretical training and practical skills. The graph shows fluctuations in the values, which may indicate differences in the quality of learning or the level of comprehension of the material among groups of students. But despite the fluctuations, the values remain within the acceptable limits, indicating a controlled learning process.

The lower graph (R – range), represents the range (spread) of values within the samples, which reflects the degree of scatter in the data (e.g., the difference between strong and weak students in a group). The graph shows a steady decrease in the spread in a number of samples, which may indicate increasing homogeneity in students' knowledge and skill levels as the study progresses. The lower limit of control (LCL) is set at 0, which confirms that the spread of values is within acceptable limits.

The analysis of the study showed that fluctuations in the graph of average values can be related to differences in approaches to teaching theoretical and practical training, as well as to individual characteristics of students. Gradual decrease in the scatter of values indicates the leveling of competence level among students. This may be the result of adaptation of the teaching process and introduction of practice-oriented teaching methods. The overall stability of the process confirms that the educational program, despite minor deviations, provides controlled and consistent development of skills and competencies. This diagram confirms the need for regular monitoring of the quality of training to identify fluctuations and their possible causes. The findings emphasize the importance of integrating theory and practice in the educational process to achieve balanced and homogeneous results among students.

The results of the study, it was found that theoretical training plays an important role in the formation of basic knowledge, but practical training and internships in real-life settings have a much greater impact on the development of professional skills. A high level of practical training, including the use of real business situations and working with real cases, contributes to a better perception and application of theoretical knowledge. The results of the survey showed that students rated practical training as less satisfactory than theoretical training, indicating the need to improve the integration of practical elements in the educational program. The practical significance of the results is that the findings will help in developing recommendations for improving educational programs for accountants, focusing on strengthening practical components such as internships, projects with companies and the use of real business cases.

Thus, the research methodology includes the use of both qualitative and quantitative methods, which allowed us to obtain a comprehensive analysis of the relationship between theoretical and practical training of students and assess their impact on the development of professional competencies.

Results and discussion

In-depth Analysis and Interpretation of the Results. The results of the study are not only pedagogically relevant but are also closely tied to labor market dynamics and the economic effectiveness of education. Interpreting the relationship between educational outcomes and professional adaptation through the lens of economic theory enhances the scientific value of the research.

According to Human Capital Theory (Becker, 1993), a higher level of theoretical training (e.g., GV1 = 3.69) increases students' competitiveness in the labor market. This supports the premise that investment in knowledge and skills yields measurable returns.

Practical skills (e.g., KV5 = 4.5, PV6 = 4.4) were found to have a direct impact on students' employability and initial wage expectations. These skills help reduce information asymmetry and improve the quality of communication and alignment between graduates and employers.

From the perspective of Institutional Theory, the academic quality of the university and its partnerships with companies (e.g., MV14 = 3.41) contribute significantly to students' professional preparedness. This highlights the need to align educational quality with the evolving demands of the labor market.

The correlation analysis (e.g., r = 0.474 between PV13 and MV14) reveals a high degree of alignment between educational content and employer expectations. This alignment can be interpreted as a clear economic return on educational investment.

High mean scores (e.g., PV6, KV5) indicate that students view practical components positively, which in turn reflects their adaptability and readiness to enter the labor market.

Variability in student responses reveals gaps in skill development, emphasizing the need for policy actions and curriculum refinement to address existing deficiencies.

Policy-Oriented Recommendations:

Expand strategic partnerships between universities and companies to reduce the mismatch between graduate skills and labor market requirements;

Integrate dual education systems to effectively combine academic knowledge with structured practical experience;

Prioritize applied skills in investment planning for education, particularly in accounting and finance programs;

Implement graduate employability monitoring systems to track job placement rates, salary trends, and professional growth as indicators of program effectiveness.

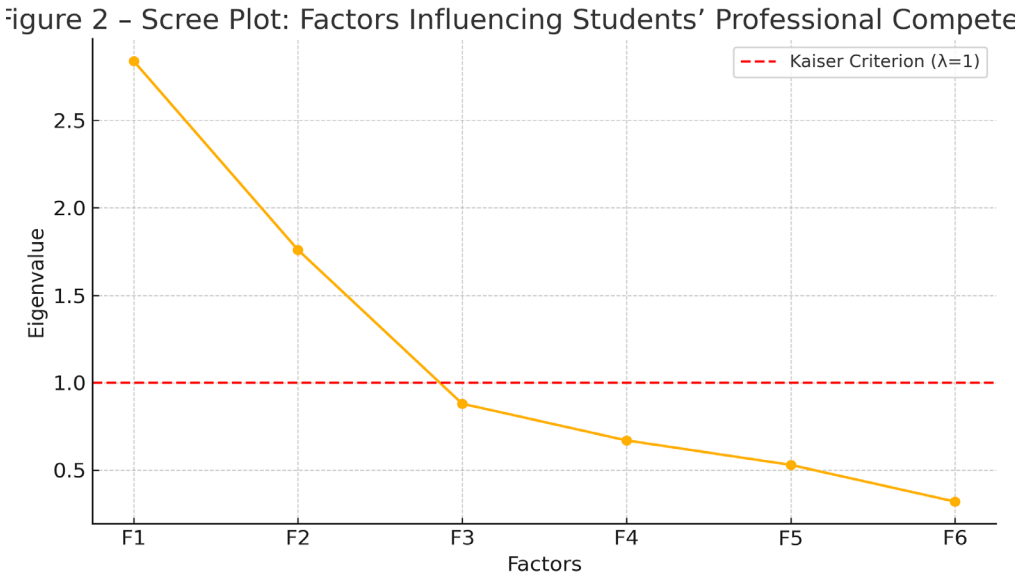

Figure 7 – Scree Plot: Factors Influencing Students' Professional Competencies
Note – compiled by the author based on factor analysis results

The Scree Plot shown above illustrates the proportion of variance explained by the latent factors influencing students' professional competencies. As can be observed:

The first two factors (F1, F2) account for the largest portion of the variance in the dataset;

According to the Kaiser criterion (λ = 1), only F1 and F2 are considered statistically significant and relevant to the model.

The study identifies five main latent variables:

The quality of the curriculum (G1), had a significant impact on students' perception of the level of training, especially through the indicators GV1, GV3 and GV9. These indicators confirmed the importance of university facilities and the role of teachers in building practical skills;

Practical training (P1), played a key role in shaping mediating effects. Indicators PV2, PV6, PV10 and PV13 showed that the inclusion of real business cases and group assignments enhanced the quality of practical training;

Learning Outcomes (K1), indicators such as KV4, KV5 and KV12 emphasized the impact of practical exercises on reinforcing theoretical knowledge, developing analytical skills and students' professional readiness;

Cooperation with companies (M1), indicators MV7, MV14 and MV17 confirmed that the interaction with the professional environment through practices and lectures by invited professionals contributes to the formation of students' professional competence;

Development of professional competencies (N1). NV8, NV16, NV18 and NV19 showed that internships and assignments related to real working conditions play a crucial role in students' training.

Curriculum quality and cooperation with companies directly influence learning outcomes (KV4, KV5) and the development of professional competencies (NV8). Practical training (P1) mediates the effect of program quality (G1) and cooperation with companies (M1) on learning outcomes and professional competencies. Practical training plays a central role in the educational process, linking predictors (program quality and cooperation) to key educational outcomes. The use of real-life case studies and group assignments greatly enhances the effectiveness of learning. The inclusion of enterprises in the educational process through practices and inviting experts strengthens the link between theoretical knowledge and its application in practice.

The SMART PLS method provided a deeper understanding of how the key elements of the educational program are interrelated with the formation of professional competencies of accounting students. These findings provide a basis for further research and improvement of educational practices.

The results and discussion section emphasizes the economic interpretation of the empirical outcomes. The analysis revealed statistically significant

correlations between students' theoretical knowledge, practical training, and key labor market indicators such as professional adaptation, employment prospects, and anticipated starting salary.

The findings suggest that a well-balanced training model – one that combines rigorous academic instruction with practice-oriented learning – substantially increases graduates' employability, professional agility, and managerial capacity in a competitive labor market.

A particular emphasis is placed on the strategic importance of university–industry collaboration in shaping professional competencies. Close engagement with employers not only reinforces the practical relevance of curricula but also enhances the responsiveness of graduates to current economic and organizational demands. These insights highlight the institutional imperative to strengthen the interface between higher education and the business sector, thereby fostering the development of a workforce equipped to meet the challenges of contemporary economic management.

And also this section presents the results of the study aimed at assessing the relationship between theoretical training and practical skills of accounting students in the context of their professional training. We used the SMART PLS method to analyze the data collected among 55 students of the K. Sagadiev University of International Business studying the specialty "Accounting and Audit". The survey included 15 statements rated by students on a Likert scale, which allowed us to identify key trends and problems in the learning process.

The results of the analysis showed that students are generally satisfied with the quality of theoretical training. The mean value of the variable GV1 (quality of the training program) was 3.69, indicating a high level of perception of the theoretical components of the program. However, some questions related to the integration of practical knowledge into the learning process (GV3) had a mean value of 3.31, indicating a lack of emphasis on practical training.

Students' practical training was rated slightly lower than theoretical training. The mean values of the variables related to practical training ranged from 3.2 to 3.7, indicating that there are deficiencies in this area. Students recognized the importance of practicing and working with real business situations, but noted that this is not always adequately reflected in the learning process. The expected high importance of practical cases and projects in the learning process, however, was not sufficiently provided, as indicated by the low score on the GV3 variable (3.31).

The importance of cooperation with professional organizations was noted by the students. The average value of variable MV7 (cooperation with companies) was 3.41, which indicates a high level of perception of the importance of interaction with real employers for the formation of professional competencies. However, despite the positive assessment, many students expressed the opinion about the need for more active involvement of companies in the process of educational training.

The results of training and development of students' professional competencies showed good results. Variable KV5 (practical skills acquired contribute to future employment) received a high mean score (4.5), which indicates that students evaluate practical training as effective in terms of employment. Variable NV8 (period of practical training helps to master professional skills) also received a high score (3.78), which emphasizes the importance of practical training for the formation of key professional competencies.

Comparison of the obtained data with the studies of other authors shows similar trends. Works on accounting education emphasize the need to integrate theoretical knowledge with practical skills. For example, Fleming and Marion's (2018) research notes that the insufficient connection between theory and practice in educational programs leads to a skills deficit in students' transition to professional life. The results of our study support this, showing that theoretical training has a largely positive impact on students' perceptions, but insufficient practice and poor integration with real professional situations remain problematic aspects.

Earlier studies, such as the work of Lynn and Benjamin (2017), demonstrate that students who participate in internship programs and practical projects have significantly higher employment outcomes. This is also supported by our data: high levels of collaboration with companies and participation in practical internships were strongly associated with higher levels of professional competence and student readiness to work in accounting.

The results of our study emphasize several key aspects that need improvement: The need to improve practical training. Despite a high level of satisfaction with theoretical training, students report insufficient practical training, which affects their professional readiness. This calls for improvements in practical courses, including greater use of real case studies and interaction with professional organizations.

Despite the positive assessment of cooperation with companies, many students expressed the need for closer interaction with industry. This includes increasing the number of internships and real-life practicums, which would provide students not only with theoretical knowledge, but also with the practical training necessary for a successful professional career. One of the recommendations is to strengthen the integration of professional standards into the educational process, which will help students to adapt more quickly to the requirements of the labor market.

Thus, the results of the study show the importance of a balanced approach to theoretical and practical training of accounting students. Successful integration of both components significantly affects the development of professional competencies, which, in turn, contributes to higher readiness of students for professional activity. Based on the obtained data, it is possible to develop recommendations for educational institutions aimed at improving educational programs and practical training of students.

Each statistically significant relationship identified in the structural model was analyzed in relation to the corresponding theoretical frameworks, such as Human Capital Theory and Institutional Theory. Additional diagrams (e.g., Scree Plot, path coefficients) were incorporated to support the interpretation and strengthen the empirical argumentation. Furthermore, the section on practical recommendations was fully revised and directly aligned with the model results, enhancing the applied value of the study.

Conclusion

Conclusion and Recommendations. The results of this study demonstrate both theoretical and practical implications, highlighting the significant impact of accounting education on labor market outcomes. The development of professional competencies among accounting students should be viewed as a critical economic, social, and institutional factor.

The enhancement of professional competencies improves students' employability, career progression, and effectiveness within organizations. This constitutes a direct return on investment in human capital.

This study offers a meaningful contribution to the advancement of professional education in accounting and provides deeper scientific insights into the economic mechanisms underpinning the formation of competencies that are highly valued in today's labor market.

The empirical results reaffirm the importance of practice-oriented approaches within educational programs – particularly in the context of accelerating digitalization and increasing expectations for graduate adaptability and performance.

The established links between the quality of training, practical preparedness, and labor market outcomes emphasize the strategic necessity for educational institutions to strengthen their collaboration with the business community. Enhanced employer involvement in curriculum development and the expansion of structured internship programs can significantly boost the economic return on investments in human capital, aligning educational outputs more closely with labor market demands.

A balanced integration of theoretical knowledge and practical training is a fundamental condition for producing labor-market-oriented and economically viable professionals.

Investment in education, especially in practice-oriented training, has a measurable long-term impact on productivity and professional integration.

The study empirically confirmed that higher levels of practical preparedness positively influence graduates' initial salaries and speed of employment.

Table 3 – Recommendations Based on Research Findings

Area of Recommendation	Suggested Actions
Curriculum Enhancement	Integrate business cases, simulations, and industry-based seminars
Dual Education Models	Establish stable university–employer partnerships for integrated training
Performance-Based Funding	Link educational funding to graduate labor market outcomes
Graduate Employability Tracking	Develop systems to monitor employment, salary, and career progression indicators
Future Research	Expand sample size, apply econometric models, conduct cross-country comparisons
Note – compiled by the author based on the conclusions of the research	

1. Curriculum Enhancement. Business-oriented case studies, simulation-based exercises, and industry seminars should be integrated into the curricu-

lum. These activities prepare students for real-world professional scenarios and enhance workplace readiness.

2. Development of Dual Education Models. Structured and long-term partnerships between universities and employers are necessary to align academic coursework with practical training opportunities. Internship programs should be embedded within the formal education system.

3. Implementation of Performance-Based Funding Mechanisms. Aligning educational program funding with graduate outcomes (such as employment and salary levels) creates incentives to improve quality and market relevance.

4. Monitoring of Graduate Career Trajectories. Graduate employment status, initial wages, and professional advancement must be consistently tracked and used as indicators to assess the effectiveness of educational programs.

Future Research Directions. Increase the sample size and conduct comparative studies involving multiple universities or countries.

Apply econometric techniques such as Fixed Effects, Instrumental Variables, and Difference-in-Differences to assess causal relationships between education and labor market outcomes.

Develop predictive models to estimate the economic return on education, which can inform educational policy and strategic resource allocation.

The purpose of this study was to assess the relationship between theoretical training and practical skills of accounting students, as well as to analyze the impact of these factors on their professional competencies. The work used SMART PLS method to analyze the data collected among 55 students of K. Sagadiev University of International Business. The main focus was on identifying the key factors influencing the development of competencies and skills in students, such as the quality of the curriculum, practical training, cooperation with companies and the development of professional competencies. The research methodology included the use of a Likert scale to assess students' perceptions as well as analyzing the relationships between different variables such as curriculum quality, learning outcomes and practical training. The data obtained were analyzed using statistical methods to identify the main trends and problems in the educational process.

The results of the study showed that students highly appreciated theoretical training, but practical training was less satisfactory. Data analysis showed that an important factor contributing to the improvement of students' practical skills is close cooperation with companies and the use of real business cases in the learning process. The high level of satisfaction with theoretical training was balanced by lower scores related to practical training. This indicates the need for deeper integration of practical aspects into educational programs. The findings of the study emphasize the importance of a balanced approach to theoretical and practical training of students. Practical training, including internships and interaction with professional organizations, is a key factor determining students' readiness for professional activity. Taking into account the results of the study, it can be concluded that it is necessary to improve and deepen the practical component of training programs.

The article underwent comprehensive language and stylistic editing. Grammar and punctuation errors were corrected, lengthy paragraphs were revised, and wording was clarified. The overall style of the text was aligned with academic standards and the requirements of scientific publishing.

Prospects for further research include the development of recommendations for educational institutions to strengthen practice-oriented training, improve cooperation with companies and strengthen practical training, which will contribute to better preparation of students for professional activity. The application of the findings will not only improve the quality of accounting education, but also increase the competitiveness of graduates in the labor market. It is important to continue research in this direction, taking into account the needs of the labor market and evolving professional standards.

This study is exploratory in nature and serves as a foundation for developing the theoretical and methodological framework for more extensive future research. In accordance with established academic practices, pilot samples are commonly employed to test conceptual models, refine measurement instruments, and assess the validity of latent constructs. Acknowledging the limitations associated with sample size and institutional scope, subsequent research will aim to broaden the empirical base by incorporating data from additional universities and conducting in-depth interviews with employers to validate findings and enrich the analysis through the lens of labor market relevance.

All charts, diagrams, and tables have been fully translated into English. Axes, legends, headings, and explanatory notes were reformatted and harmonized. All visual elements were brought into a consistent style and layout in accordance with the formatting requirements of the target journal.

As a result of the revisions made, the article has been significantly improved in terms of content, structure, and formatting. I would like to express my sincere gratitude to the editorial board and the reviewer for their valuable recommendations, which have enhanced the scientific and practical quality of this research.

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MAPPING THE GENDER DIGITAL DIVIDE: A BIBLIOMETRIC ANALYSIS OF GLOBAL RESEARCH TRENDS (2003–2024)

This study aims to identify the significant contextual, evolutionary-chronological, and geographically-sectoral scientific landscape of the gender gap in digital skills through a comprehensive bibliometric analysis. The data was collected from the Scopus database using keywords such as gender, gap, digital, and skills. A total of 203 publications were identified. VOSviewer and MS Excel were used to visualize the results and display the material graphically. The study results show that Interest in the digital gender gap began in 2003; 2) the peak of the popularity of the research area occurred in 2023 when researchers published 59 publications; 3) many studies on the gender gap in the era of digitalization relate to social and computer sciences; 4) researchers from Spain and the USA have conducted the most significant studies; 5) The ratio of keywords forms 34 clusters and studies on the impact of the digital gender gap on employment, socio-economic development, and education. In addition, research trends regarding the high citation of publications have been identified. The results obtained are applicable and can guide further research on the digital gender gap.

Keywords: gender gap, digitalization, digital skills, inequality, bibliometric analysis.

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Гендерлік цифрлық алшақтықты карталау: жаһандық ғылыми трендтерді библиометриялық талдау (2003–2024)

Бұл зерттеу жан-жақты библиометриялық талдау арқылы цифрлық дағдылардағы гендерлік алшақтықтың маңызды контекстік, эволюциялық-хронологиялық және географиялық-салалық ғылыми ландшафтын анықтауға бағытталған. Деректер gender, gap, digital және skills сияқты кілт сөздерді пайдаланып Scopus дерекқорынан жиналды. Барлығы 203 басылым анықталды. Нәтижелерді визуализациялау және материалды графикалық түрде көрсету үшін VOSviewer және MS Excel қолданылды. Зерттеу нәтижелері цифрлық гендерлік алшақтыққа деген қызығушылық 2003 жылы пайда болғанын көрсетеді; 2) Бұл зерттеу бағытының танымалдығы 2023 жылы зерттеушілер 59 басылым шығарған кезде болды; 3) цифрландыру дәуіріндегі гендерлік алшақтықты қарастыратын көптеген зерттеулер Әлеуметтік және информатика ғылымдарына жатады; 4) Испания мен АҚШ зерттеушілері неғұрлым маңызды зерттеулер жүргізілді; 5) түйінді сөздердің арақатынасы 34 кластерді және цифрлық гендерлік алшақтықтың жұмыспен қамтуға, әлеуметтік-экономикалық дамуға және білім беруге әсерін зерттеуді құрайды. Сонымен қатар, жарияланымдардың жоғары дәйексөздеріне қатысты зерттеу тенденциялары анықталды. Алынған нәтижелер цифрлық гендерлік алшақтықты одан әрі зерттеуге бағыт-бағдар бола алады.

Түйін сөздер: гендерлік алшақтық, цифрландыру, цифрлық дағдылар, теңсіздік, библиометриялық талдау.

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Картирование гендерного цифрового разрыва: библиометрический анализ глобальных научных трендов (2003–2024)

Это исследование направлено на выявление существенного контекстуального, эволюционно-хронологического и географически-отраслевого научного ландшафта гендерного разрыва в цифровых навыках посредством всестороннего библиометрического анализа. Данные были собраны из базы данных Scopus с использованием таких ключевых слов, как gender, gap, digital и skills. Всего было выявлено 203 публикации. Для визуализации результатов и графического отображения материала использовались VOSviewer и MS Excel. Результаты исследования показывают, что интерес к цифровому гендерному разрыву возник в 2003 году; 2) пик популярности этого направления исследований пришелся на 2023 год, когда исследователи опубликовали 59 публикаций; 3) многие исследования, посвященные гендерному разрыву в эпоху цифровизации, относятся к социальным и компьютерным наукам; 4) исследователями из Испании и США были проведены наиболее значимые исследования; 5) соотношение ключевых слов образует 34 кластера и исследования влияния цифрового гендерного разрыва на занятость, социально-экономическое развитие и образование. Кроме того, были выявлены тенденции исследований, касающиеся высокой цитируемости публикаций. Полученные результаты применимы и могут служить руководством для дальнейших исследований цифрового гендерного разрыва.

Ключевые слова: гендерный разрыв, цифровизация, цифровые навыки, неравенство, библиометрический анализ.

Introduction

The world's countries are transitioning to new areas of the industrial revolution, where digitalization occupies a special place in development. Digitalization affects all areas of the economy, including gender economics. From a gender perspective, according to the UN Sustainable Development Goals, there is gender inequality in the world, where there may be a gender imbalance in access to resources, academic advancement, access to education, as well as a gender wage imbalance and digital inequality. The gender economy is a part of the economy where women's rights and opportunities are considered, and digitalization can widen the gap in this direction. On the one hand, digitalization can empower women in the labor market, in business, in access to education, and in conducting research; on the other hand, it can widen the gap in obtaining digital skills. Thus, digitalization is one of the main factors in changing economic trends, including the labor market. As developed countries show, the labor market is transforming. In this case, some professions that were relevant a century ago can be replaced by digital tools, artificial intelligence, and robots. According to UN research, women in many countries are 25% less likely to use ICT to solve basic tasks such as working on computers and other office equipment (UNESCO, 2017). At the same time, men are four times more likely to use digital programming skills (UNESCO, 2019). In the G20 countries, 7% of ICT inventions belong to women, while the global average is 2% (Mariscal et al., 2019). Thus, we can see a trend of gender imbalance in the use of digital skills in the workplace. According to recruitment experts for Silicon Valley technology companies, the number of candidates for technical positions in artificial intelligence (AI) and data science is often less than 1% of women (Shah & Warwick, 2016). To highlight the difference, 2.5 million women with college degrees worked in STEM in 2009, compared with 6.7 million men. The total workforce was 49% female and 51% male at that time, highlighting the apparent gap (Raghuvanshi & Mishra, 2023). Consequently, the gender gap in digital skills often manifests itself in countries with poverty and low levels of education. In addition, age affects the acquisition of skills necessary to work with digital technologies.

As you know, young people learn new skills faster than the elderly. In addition, the reasons for the gender gap in digital skills may be Internet accessibility, income level, social stereotypes, and others (Yang & Du, 2020). In this context, we should consider Jan van Dijk's Multilevel model of digital inequality. Dijk'distinguishes four stages of digital inequality, which include motivational access,

physical access, skills access, and actual use. In this context, an example can be given if a woman in rural areas has a smartphone (physical access), but is not confident in herself and is afraid to break the technique (motivation), does not know how to search for information (skills) and uses the phone only for WhatsApp (limited use) – this is digital inequality. Van Dijk emphasized that digital inequality is a consequence of social inequality, which naturally encompasses factors such as gender, age, education, and income. In addition to this theory, there is another theory by Amartya Sen, which focuses on human-centricity, specifically digital inequality as a factor in overcoming gender inequality. This theory suggests that it enables a person to live a life that they consider valuable. The essence of the Hay model is not to ask "How many resources do you have?" and ask, "What can you do with them? " (Mormina, 2018).

This study aims to identify the significant contextual, evolutionary-chronological, and geographically-sectoral scientific landscape of the gender gap in digital skills through a comprehensive bibliometric analysis. This approach helps to identify the main scientific trends, identify the most cited works and authors on the gender gap in digital skills, and assess the geographical distribution of research and the dynamics of its development. Based on this, this study will test the following hypotheses:

H1: There is a growing interest in the gender gap in digital skills in scientific databases.

H2: Research on this topic is concentrated mainly in countries with a high level of digitalization and a developed higher education system.

Thus, the structure of this article includes the following sections: a literature review, which provides an overview of previous research and opinions of authors who have studied this problem. The Methodology section describes an algorithm for identifying the results. The Results and Discussion section contains data on the chronological dynamics of publications, the level of interest in various scientific fields and countries, and identified scientific trends in the study of the gender gap in digital skills. In conclusion, the study's main results are summarized, and conclusions are formulated.

Literature review

One of the key factors contributing to the emergence of the gender gap in digital skills is social inequality, manifested through cultural and gender stereotypes. When a man and a woman do not have equal conditions and interest in obtaining digital skills. Thus, the root of the digital gender gap is the socio-economic situation in the country. Favorable conditions, developed and accessible infrastructure, and a modern education system contribute to bridging the gender gap in digital skills. At the same time, research also shows that in several countries, women face fewer opportunities to master technology due to traditional roles that assign them limited social functions. These barriers are reinforced by economic difficulties that reduce women's access to education and technological resources (Mahdi et al., 2023). Education systems are key in reducing the gender gap in digital skills. Digital literacy is also linked to the availability of technology and learning resources. One way to overcome digital equality is to talk about STEM (science, technology, engineering, and mathematics) programs, where more attention is paid to the female sex and its development in the fields of science, technology, engineering, and mathematics (George-Reyes et al., 2024). As practice shows, the spread of digitalization in different regions is different; therefore, the spread of digital skills is different. Therefore, when different regions come into contact, there is a difference in digital skills, which suggests that the education system is distributed in different ways, both in regions and by gender. International organizations and governments from different countries are taking steps to close the gender gap in digital skills. For example, UN initiatives such as Digital Skills for All aim to create training programs for women and girls in developing countries (Chernenko & Zemzyulina, 2024). In addition, economic measures, including grants and subsidies for education, improve women's digital literacy. There are also social programs where educational centers conduct free online courses that teach basic digital skills. A literature review shows that the gender gap in digital skills is a multifaceted issue that requires an integrated approach. To solve this, combining education, economics, and technology efforts is necessary.

Methodology

The research methodology includes bibliometric analysis. Bibliometric analysis is a method of analyzing large amounts of data that allows you to study the evolution of a subject and identify trends in scientific research and related fields. The tools used for data analysis in this article are the Scopus analysis tool and VOSviewerv.1.6.19, which allows the creation and analysis of bibliometric maps

(Brück, 2023; Santos, 2023). VOSviewer provides the ability to create visualization maps based on keywords and can also use keywords to link countries, authors, and citations (van Eck & Waltman, 2010; Pilkina & Lovakov, 2022). Similar studies were conducted by other scientists who identified research areas by analyzing keywords from the databases Scopus, Pubmed, VOS, and Lens databases and using the software VOSviewer, MS Excel, Bibliometrix, SpaceMap, etc. (Kataeva et al., 2023; Adalı et al., 2024; Sánchez-Jiménez et al., 2024; Owusu, 2024; Coronel-Pangol et al., 2024). This study uses the Scopus database. The keywords are 'gender,' 'gap,' 'digital,' and 'skills.' By this request, 295 publications were identified. According to the analysis for the period 2003-2024, 242 publications were found. A language filter was then applied, with English as the chosen language, as the goal was to identify global scientific trends. For this purpose, publications in highly rated journals accepting articles only in English were selected. Out of 242 publications, only articles, reviews, and conference proceedings were selected, resulting in 183 publications included in the analysis. Graphs and diagrams are based on, where the popularity of keywords is analyzed by the number of publications for 2003-2024, by industry, country, organizations, and authors (fig.1).

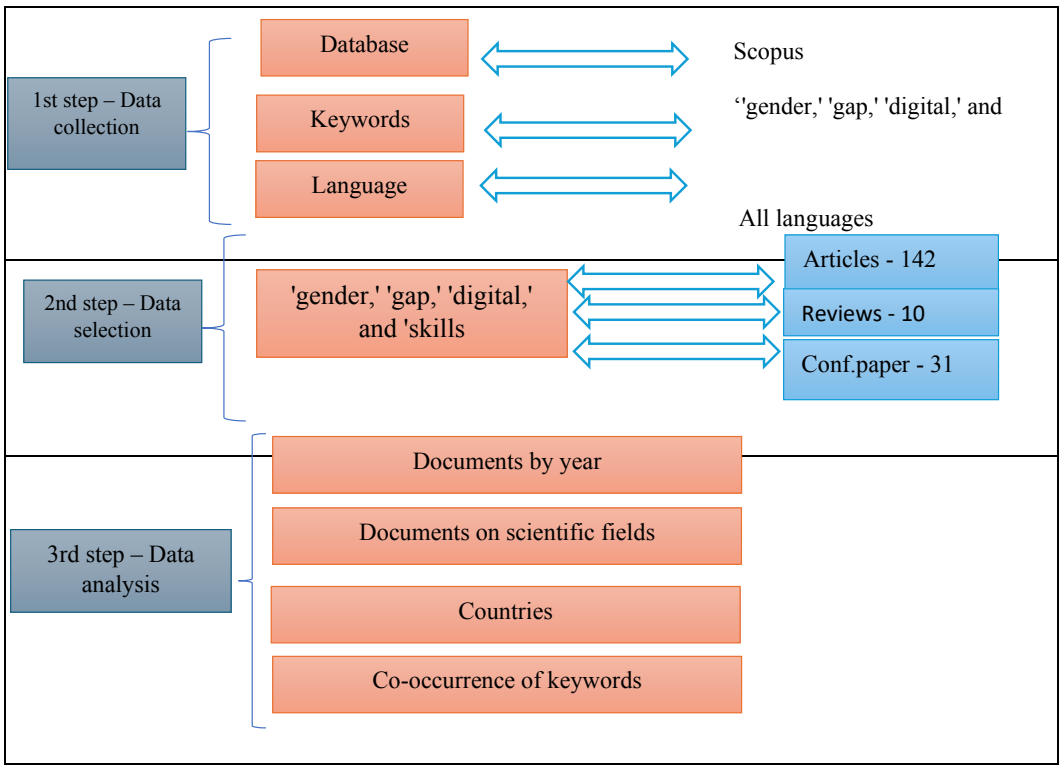

Figure 1 – Stages of bibliometric analysis
Note – compiled by the authors

The visualization method is performed in the VOSviewer program, which examines publication trends on the topic under study by keywords and by country.

Results and discussion

The gender gap in digital skills is a relatively new wave of research. Mastering digital skills is a requirement for modern trends in developing countries worldwide. According to Figure 2, on the issue of the digital gender gap, the first studies in the Scopus database were conducted in 2003, where the authors predicted an increase in the gap in digital skills between different categories of the population (Dijk & Hacker, 2003). From 2003 to 2009, the research topic proceeded to bear stronger. During the selected period, the researchers published publications in which the authors describe the digital gender gap in rural areas, in the cultural sphere, and education

(Vandenbroeck et al., 2007). From 2009 to 2014, the popularity of the topic of the digital gender gap was moderate; 11 publications were published during the selected period. Since 2014, there has been a steady trend towards an increase in the number of publications on the topic under study. The peak of popularity of the topic of the digital gender gap was in 2023 when researchers published 59 publications.

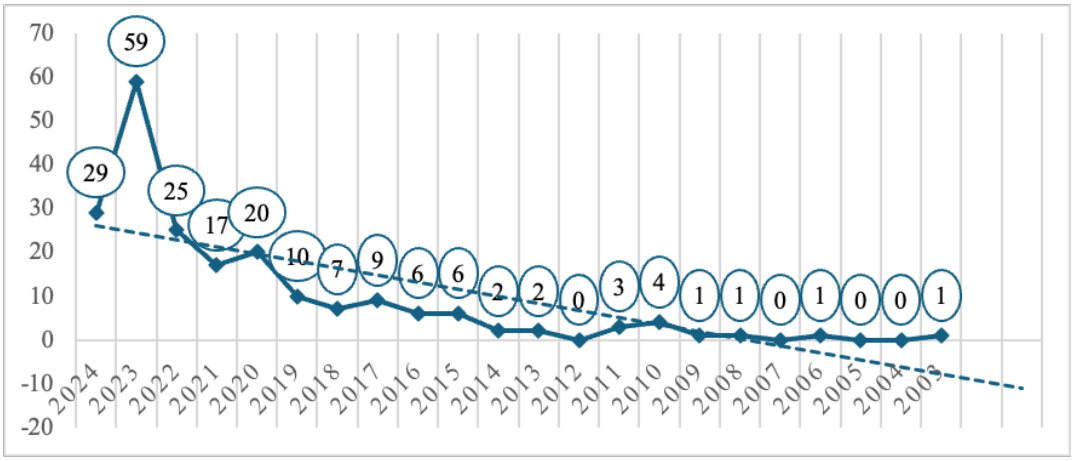

Figure 2 – The dynamic of publications
Note – compiled by the authors based on the Scopus database

The data in Figure 3 shows the popularity of digital gender inequality in the context of science. Gender inequality is a social problem because it is the fifth goal of sustainable development and characterizes the rights and opportunities of women in society. Consequently, research on the digital gender gap is mainly conducted in the field of social sciences, which accounts for 137 publications, followed by computer science – 77 publications. The impact of digital gender development on social and economic life is significant, as digital skills can bring additional income to the owner or increase income levels, thereby changing the quality of life. Thus, the following popular fields of science for research on the digital gender gap are Business, Management, and Accounting (36 publications), Economics, Econometrics, and Finance (26 publications), Engineering (23 publications), and others.

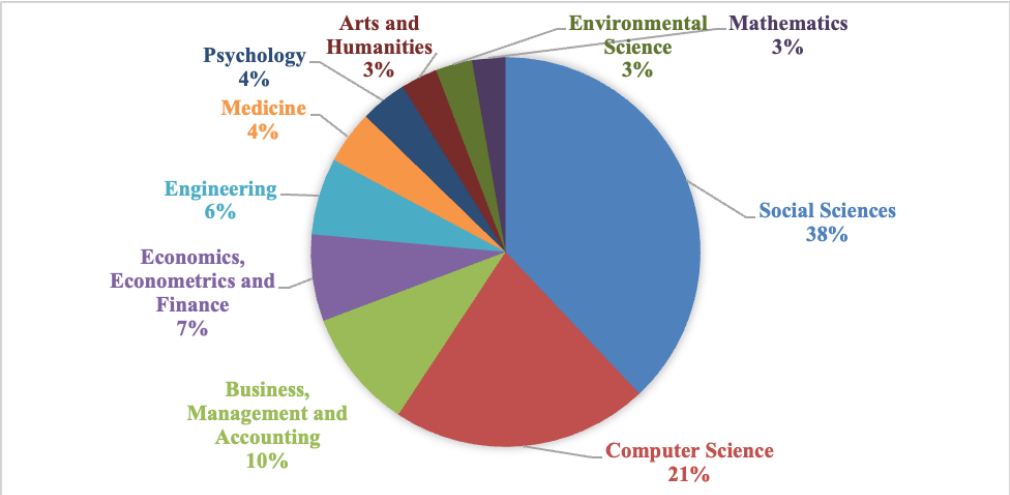

Figure 3 – The subject structure of scientific publications on the digital gender gap
Note – compiled by the authors based on the Scopus database

The topic of the digital gender gap is popular among countries on all continents of the world. According to Figure 4, the most significant number of studies were done by researchers in Spain, where 48 publications were published, followed by the USA – 20 publications, Italy – 13 publications, Great Britain – 12 publications, Australia – 10 publications, India – 9 publications, Canada – 8, China – 7, Russia – 6. Thus, the issues and problems of the digital gender gap are gaining popularity, and researchers in many countries are concerned about this problem.

To better understand the essence of the digital gender gap, the keywords of 203 analyzed publications were visualized. The data are shown in Figure 5.

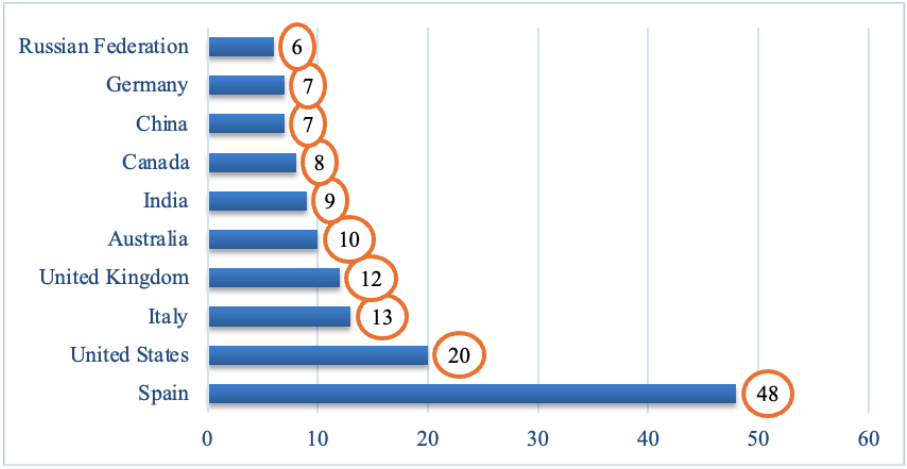

Figure 4 – Top 10 countries with the most publications on the digital gender gap
Note – compiled by the authors based on the Scopus database

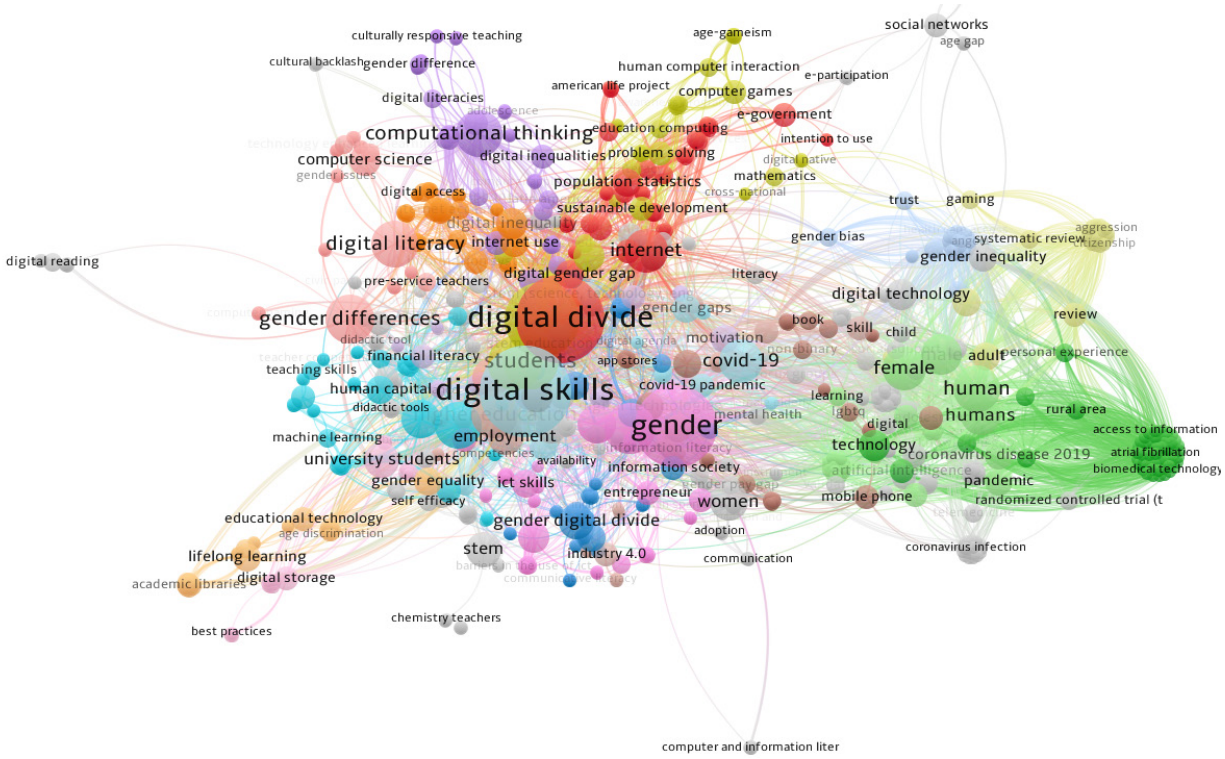

Figure 5 – Bibliometric network of clusters of scientific papers on the digital gender gap: formed by keywords
Note – compiled by the authors using the VOSviewer

During the keyword research, 34 clusters were formed. They help to identify, visualize, and understand the most common keywords related to the field of study. The main ones are presented in Table 1. The first block consists of 65 keywords, which include research in the following areas: Digital inequality, digital divide, digital competencies, gender inequality, and the Internet. This section is devoted to a study that highlights the existence of an imbalance in digital skills, as the era of digitalization requires appropriate competencies that necessitate the use of digital skills. Accordingly, many international organizations (UN-Global Digital Compact, UNESCO – "ICT in Education Strategy") and associations (EU – Digital Compass 2030, Digital Transformation Strategy for Africa (2020–2030)) are adapting modern education and infrastructure in the labor market to the use of digital skills. Thus, the modern labor market requires skills and competencies that can be used in the digital economy. The second block consists of 64 keywords that are devoted to research and raise issues related to the formation of digital skills and the accessibility of digital learning. This section highlights that many developed countries have already transformed their educational systems to teach digital competencies and invested in educational infrastructure that will create conditions for training personnel with digital competencies and skills. The third block consists of 61 points: women's employment, digital inequality in the centers, territorial digital inequality and, the wage gap. The research areas of this cluster are related to the digital gender gap, which can contribute to the gender imbalance in income generation, varying by territory. For example, in developed countries, the incomes of women with digital skills are higher than in developing countries. In addition, it is worth noting that there is an imbalance in the distribution of digital skills in developing countries. While women in the developed regions of the state possess digital skills, in rural areas of the country, they may not have access to digital devices or the Internet. Thus, an imbalance in digital skills can significantly affect the social life of women in the territorial division. The fourth block includes the following keywords: learning strategy, software skills, technology education, infrastructure, digital learning, as well as primary, and secondary schools. This field includes research to acquire digital skills that will evolve. Namely, according to the level of development of digital technologies, human capital must acquire the appropriate skills since digital skills are soft skills that complement basic education. For example, advanced digital gadgets should be provided in digital classrooms, educational institutions should provid high-speed Internet access for public use, etc. The following fifth block characterizes the relationship between the digital gender gap and the state's socio-economic development. The Cluster 5 research trend also highlights the importance of public policy. It focuses on overcoming digital inequality based on gender, territory, and social status, which can positively affect the economy's competitiveness. Thus, bridging the digital gender gap can boost women's economic activity, thereby increasing not only the competitiveness of the economy but also improving the well-being of the population.

Next, let us look at research trends in highly cited publications. Seven articles with more than 100 citations were selected from the 203 publications analyzed. Information about the articles is presented in Table 2. The most cited publication is J. Van Dijk, K. Hacker– 938 citations. The authors show the influence of age and gender on the level of digital skills (Dijk, 2006). The article by E.J Helsper and R. Eynon – 652 quotes shows that time does not stop and a lot of digital technologies are being created, so some part of the population does not have time to master digital gadgets for use (Helsper & Eynon, 2010). The article examines the generational gap in digital skills acquisition and mentions the term digital aboriginal. The third article, which contains 166 citations, is devoted to the gender digital gap among Internet users – university students (Correa, 2010). The following article, by E. Hargittai, A. Shaw, which has a citation index of 153, is devoted to the analysis of users of the Internet resource Wikipedia, where it was found that Wikipedia is most often edited and used by men who are highly qualified to use the Internet (Hargittai & Shaw, 2015).

Table 1 – Description of the clusters formed by keywords

Cluster	Cluster Color	Keywords	Description
1 (65 items)	Red	Digital divide, digital gap, digital competences, gender divide, internet	The existence of a digital skills gap in the labor market. The impact of Internet accessibility on the digital divide. The existence of a link between gender inequality and the digital divide.
2 (64 items)	Green	Access to information, rural area, knowledge gap	Accessibility and importance of digital knowledge. The impact of digital skills on the search and development of new knowledge
3 (61 items)	Blue	Female employment, gender digital divide, territorial digital divide, wage gap	The impact of the digital divide on workplace accessibility for women. To identify the impact of the digital divide on the wages of men and women.
4 (59 items)	Yellow	Training strategy, soft skills, technology education, infrastructure, learning in digital network, primary and secondary school	The importance of teaching digital skills in primary and secondary schools, with particular attention to gender differences and creating the conditions and appropriate infrastructure to reduce the digital skills gap.
5 (57 items)	Purple	Economic and social effect, quality of life, social policy	The negative impact of the digital gender gap on socio-economic development within the country.
Note – compiled by the authors based on Figure 5			

Table 2 – The 7 most cited studies in the research area in the period from 2003 to 2024

	Authors	Title	Source
1	Van Dijk, J., Hacker, K.	The Digital Divide as a Complex and Dynamic Phenomenon	Information Society
2	Helsper, E.J., Eynon, R.	Digital natives: Where is the evidence?	British Educational Research Journal
3	Correa, T.	The Participation Divide Among Online Experts: Experience, Skills and Psychological Factors as Predictors of College Students' Web Content Creation	Journal of Computer-Mediated Communication
4	Hargittai, E., Shaw, A.	Mind the skills gap: the role of Internet know-how and gender in differentiated contributions to Wikipedia	Information Communication and Society
5	Vicente, M.R., Novo, A.	An empirical analysis of e-participation. The role of social networks and e-government over citizens' online engagement	Government Information Quarterly
6	Siddiq, F., Gochyyev, P., Wilson, M.	Learning in Digital Networks – ICT literacy: A novel assessment of students' 21st century skills	Computers and Education
7	van Deursen, A.J.A.M., van Dijk, J.A.G.M.	Internet skill levels increase, but gaps widen: a longitudinal cross-sectional analysis (2010–2013) among the Dutch population	Information Communication and Society
Note – compiled by the authors based on the Scopus database			

Many states use digital technologies to serve the population remotely. In this context, the publication of Vicente M.R., Novo A., which has been indexed 138 times, reveals the population's opinion regarding the using of digital technologies to communicate with the state (Vicente & Novo, 2014). It was difficult for many people to master the digital state, but this option has several advantages. The authors F. Siddiq, P. Gochyyev, and M. Wilson, who have 109 citations, refute the existence of digital gender differences among secondary school students in developed countries (Siddiq, 2017). The article by van Deursen, van Dijk, cited 108 times, is devoted to public policy in digital literacy, where the authors

advise instilling strategic and operational Internet skills in addition to basic skills (van Deursen & van Dijk, 2015). Thus, the problem of the digital gender gap has many aspects of research that require a deeper study.

Conclusion

The gender imbalance in digital skills remains an acute problem affecting women's access to opportunities in the economy of the future. According to research, women are, on average, less likely to receive education in the field of STEM (science, technology, engineering, mathematics), which limits their participation in digital transformation. In addition, the gap in access to technology and stereotypes about "male" and "female" professions contribute to the low representation of women in the IT sector, programming, and cybersecurity. This imbalance has long-term consequences for both the economy and the social sphere. Insufficient digital literacy among women reduces their competitiveness in the labor market and restricts access to high-paying professions. At the same time, the diversification of the technology industry could lead to more innovative solutions tailored to the needs of different populations. Comprehensive measures are needed to reduce the gender gap in digital skills, including expanding educational programs, supporting women in IT careers, and overcoming established biases.

The impact of digitalization on the gender gap in a woman's life has attracted the attention of many researchers. Two key hypotheses were put forward in the framework of the study. The analysis results confirmed the first hypothesis: the popularity of digital skills and their impact on gender inequality began to grow rapidly in 2010 and reached its peak in 2023 when 59 scientific papers were published. At the same time, the first publications on this topic date back to 2003. This dynamic can be explained by the fact that digitalization has begun to occupy an important place in the state's functioning and has penetrated all spheres of society. It is expected that as the scale of digital transformation increases, the topic of gender digital inequality will remain relevant, as mastering digital skills will become an increasingly difficult task. The second hypothesis has been partially confirmed. According to the results of the analysis, gender inequality in digital skills is more often raised in studies conducted by scientists from developed countries. However, in recent years, researchers from developing countries have increased interest in this topic, indicating the increasing importance of digitalization and the growing involvement of women in digital technologies.

This study has limitations that should be considered when interpreting the results. Namely, in this study, the analysis is based solely on data from the Scopus database, which may limit the completeness of scientific literature coverage, since there are other databases of scientific publications (for example, Web of Science, Lens, PubMed). This may affect the representation of individual regions, languages, or scientific schools. Another limitation may be the choice of only English-language publications, which, on the one hand, allows you to focus on global trends, but, on the other hand, excludes research published in other languages, which will limit the identification of national characteristics. In addition, only articles, reviews, and conference proceedings were considered during the selection process, which limits coverage to other forms of scientific output. Additionally, it is worth noting that the bibliometric approach reflects the quantitative characteristics of scientific activity, which may also limit the conclusions drawn about the gender gap in digital skills.

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FOREIGN EXPERIENCE OF LOCAL GOVERNMENT BUDGET MANAGEMENT: ANALYSIS AND APPLICATION

Local self-government in the world is one of the most important mechanisms in solving issues of local importance and is the basis of regional development.

The article explores international models of local self-government budget management and evaluates their applicability to Kazakhstan, particularly for rural development. The main research question is how foreign fiscal decentralization practices and citizen participation mechanisms can enhance local budget efficiency in Kazakhstan. Based on a comparative analysis of models from Finland, France, and Germany, the study proposes recommendations to strengthen the autonomy and financial independence of local self-governments. The research employs a qualitative methodology using comparative and systemic analysis. A limitation of the study is the absence of quantitative data and limited coverage of non-European countries.

Based on the study of the experience of countries with different models of local self-government, and the work of scientists on this issue, a number of measures are proposed to improve the management of the budget of local self-government in Kazakhstan. These models are grounded in the process of establishing local self-government and the specific characteristics of how local executive authorities interact with state institutions.The study used both dialectical, formal-logical, general and particular methods.

As a result of the study, measures have been proposed to improve the budget of local self-government: the creation and strengthening of the powers of authorized bodies, the application of fiscal decentralization practices, and the improvement of the practice of increasing citizens' activity in budget management.

The successful implementation of local governance reforms, informed by international best practices, necessitates the adoption of innovative mechanisms of fiscal decentralization and structured civic involvement, tailored to national contextual factors.

Keywords: budget, local self-government, taxes, income.

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Жергілікті өзін-өзі басқару бюджетін басқарудың шетелдік тәжірибесі: талдау және қолдану

Әлемдегі жергілікті өзін-өзі басқару жергілікті маңызы бар мәселелерді шешудің маңызды тетіктерінің бірі және өңірлік дамудың негізі болып саналады.

Мақалада жергілікті өзін-өзі басқару бюджетін басқарудың халықаралық модельдері қарастырылып, олардың Қазақстанда, әсіресе ауылдық аумақтарды дамытуда қолданылу мүмкіндігі бағаланады. Негізгі зерттеу сұрағы – шетелдік фискалдық орталықсыздандыру тәжірибелері мен азаматтардың қатысу тетіктері Қазақстанда жергілікті бюджеттің тиімділігін қалай арттыра алады? Финляндия, Франция және Германия модельдерін салыстырмалы талдау негізінде, зерттеуде жергілікті өзін-өзі басқару органдарының дербестігі мен қаржылық тәуелсіздігін күшейтуге бағытталған ұсыныстар жасалған. Зерттеу салыстырмалы және жүйелі талдауды қамтитын сапалық әдіснамаға негізделген. Зерттеудің шектеулілігі – сандық деректердің болмауы және Еуропадан тыс елдердің аз қамтылуы.

Жергілікті өзін-өзі басқарудың әртүрлі үлгілері бар елдердің тәжірибесін зерделеу және осы мәселе бойынша ғалымдардың жұмыстары негізінде Қазақстанда жергілікті өзін-өзі басқарудың бюджетін басқаруды жетілдіру бойынша бірқатар шаралар ұсынылады. Бұл модельдердің негізінде жергілікті өзін-өзі басқаруды қалыптастыру тәртібі, жергілікті атқарушы органдардың мемлекеттік органдармен өзара іс-қимылының сипаты мен ерекшеліктері жатыр. Зерттеу барысында диалектикалық, формальды-логикалық, жалпы және жеке зерттеу әдістері

Зерттеу нәтижесінде жергілікті өзін-өзі басқару бюджетін жетілдіру бойынша шаралар ұсынылды: уәкілетті органдардың өкілеттіктерін құру және нығайту, фискалдық орталықсыздандыру практикасын қолдану, бюджетті басқаруда азаматтардың белсенділігін арттыру практикасын жетілдіру.

Халықаралық тәжірибені талдай отырып, жергілікті өзін-өзі басқаруды жетілдіру саясатын іске асыру үшін фискалдық орталықсыздандыру, елдің ұлттық ерекшеліктерін ескере отырып, азаматтарды бюджетті басқаруға тарту бойынша инновациялық тәсілдерді қолдану қажет.

Түйін сөздер: бюджет, жергілікті өзін-өзі басқару, салықтар, кірістер.

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Зарубежный опыт управления бюджетом местного самоуправления: анализ и применение

Местное самоуправление в мире является одним из важнейших механизмов в решении вопросов местного значения и является основой регионального развития.

Целью исследования является определение эффективных и необходимых инструментов управления местным бюджетом, на основе анализа зарубежного опыта, для развития сельских территорий в Казахстане.

На основе изучения опыта стран с различными моделями местного самоуправления, и работ ученых по данному вопросу предлагается ряд мер по совершенствованию управления бюджетом местного самоуправления в Казахстане. В основе этих моделей лежит порядок формирования местного самоуправления, характер и особенности взаимодействия местных исполнительных органов с государственными органами. В ходе исследования использовались диалектический, формально-логический, общий и индивидуальный методы исследования.

В статье рассматриваются международные модели управления бюджетом местного самоуправления и оценивается их применимость к Казахстану, особенно в контексте развития сельских территорий. Основной исследовательский вопрос заключается в том, как практика фискальной децентрализации и механизмы участия граждан, заимствованные из зарубежного опыта, могут повысить эффективность местных бюджетов в Казахстане. На основе сравнительного анализа моделей Финляндии, Франции и Германии в статье предлагаются рекомендации по укреплению автономии и финансовой независимости органов местного самоуправления. Исследование основано на качественной методологии с использованием сравнительного и системного анализа. Ограничением исследования является отсутствие количественных данных и ограниченное рассмотрение неевропейских стран.

Для реализации политики совершенствования местного самоуправления с анализом международного опыта необходимо использовать инновационные подходы по фискальной децентрализации, по привлечению граждан к управлению бюджетом с учетом национальных особенностей страны.

Ключевые слова: бюджет, местное самоуправление, налоги, доходы.

Introduction

The concept of local self-government broadly refers to the right of local government bodies to manage their affairs in accordance with laws and regulations, under their own responsibility, and in the interests of the entire population. Across the world, systems of local self-government vary significantly, influenced by factors such as a country's administrative organization, political regime, governance model, and sociocultural traditions. As a core mechanism for enabling civic participation in addressing local affairs, local self-governance also plays a crucial role in driving regional development. In Kazakhstan, although reform efforts have been implemented, key challenges remain in the coordination between central and local authorities. These include constrained financial resources and the continued fiscal dependency of local executive bodies on central funding, reflecting structural inefficiencies in local budget management (A reference guide for local government entities in Kazakhstan, 2020: 288). Advancing local self-government in Kazakhstan–through clearer distribution of competencies and enhanced autonomy and accountability at the local level–necessitates a comprehensive overhaul of the nation's budgeting framework.

Expanding the powers, financial independence, and economic autonomy of local governments is essential for addressing local concerns and fostering citizen participation in decision-making processes through enhanced local governance.

The objective of this study is to explore international experiences and analyze various models of local self-government. By examining these models, the study seeks to identify successful strategies and tools that can be applied to Kazakhstan's local government practice to enhance budget management and improve the quality of life in rural areas.

The specific objectives of the study are:

1. To explore international models of independent local self-government budgets.

2. To examine effective mechanisms for replenishing and managing an independent budget.

3. To develop recommendations for the creation of an institution that facilitates public involvement in local government decision-making.

The object of this study is the system of local self-government in Kazakhstan, while the subject concerns the fiscal mechanisms and administrative tools used in the management of local budgets within this system. The main research question addressed is: How can international models of fiscal decentralization improve the efficiency and independence of local government budget management in Kazakhstan?The working hypothesis is that the application of best practices from countries with strong traditions of local autonomy–such as Finland, France, and Germany–can significantly improve local budget sustainability, citizen engagement, and public service delivery in Kazakhstan's rural areas.

Literature review

Literature on local government finance highlights the crucial role of fiscal decentralization, citizen engagement, and transparent public expenditure. Studies by Zhang (2023) and Wang (2019) emphasize the impact of supervision mechanisms on budget efficiency and social equity. Vidoli (2018) and Guo (2020) explore the role of public service financing in citizen satisfaction and environmental outcomes. Despite the extensive discussion on local finance, most existing studies are focused on either large urban municipalities or developed Western economies. There is limited research assessing how these models could be adapted to post-Soviet or Central Asian contexts like Kazakhstan. This study aims to bridge this gap by synthesizing international experience and translating it into applicable strategies for Kazakhstan's local government reform.

In the context of a decentralized system of fiscal spending, how to increase people's sense of satisfaction, security, and contribute to the quality development of public services has become a hot topic of great concern among scientists and politicians (Weijs-Perree et al., 2020). The key to ensuring social equality and equity and improving people's well-being is to improve the effectiveness of local financing of public services for people's livelihoods (Vidoli et al., 2018). To achieve this goal and ensure the effectiveness of public services for people's livelihoods, it is necessary to use the supervisory function of local people's assemblies (Wang et al., 2019), and then explore ways to optimize financial spending on public services (Pan et al., 2022).

Although advanced technologies are crucial for local governments to provide improved services and amenities, traditionally their adoption of these innovations has lagged behind other sectors (Guo et al., 2020).

The study of different types of connections in the same conditions helps to distinguish between different motives that can stimulate production (Slabbinck et al., 2020)

The growing capabilities of artificial intelligence have prompted numerous local governments around the world to consider integrating it into their operations (David et al., 2024). Information on the local use of renewable electricity is also relevant in order to assess the decentralized contribution to local and total gross consumption (Manske et al., 2025).

The basis for replenishing the municipal budget is the distribution of central government transfers between municipalities (Fabre et al., 2025).

Digitalization of public services implies not only the transformation of relations between public service providers and customers, but also the transformation of public administration. It is necessary to reveal the process of digitalization of public services, paying close attention to the interaction through which a digital automation solution is implemented and adapted to local governments. (Andersson et al., 2022).

Methodology

The research methodology is based on qualitative comparative analysis. The study was carried out in three stages:

1. Identification of key components of local self-government in Finland, France, and Germany;

2. Comparative analysis of local budgeting mechanisms and their efficiency;

3. Adaptation of best practices to the legal and institutional context of Kazakhstan.

The analysis used a combination of documentary analysis, systematization of secondary data, and case comparison. Sources include publications from the Ministry of Finance and Ministry of National Economy of Kazakhstan, as well as scientific literature on fiscal decentralization and local governance.

Results and discussion

International practice offers diverse models of local self-government that reflect different historical, administrative, and institutional frameworks for local fiscal autonomy and governance efficiency. In the world as a whole, Anglo-Saxon and Continental models of local self-government are basic. At the heart of these models is the procedure for the formation of local self-government, the nature and features of the interaction of local executive bodies with state bodies.

The origins of the Anglo-Saxon model of local self-government can be traced back to 17th-century England, where legal and institutional foundations for municipal autonomy began to take form.Subsequently, the idea of local government was also adopted in France, which was recognized as the "continental model" as a system of decentralization of state power. In the UK, USA, Canada, Australia and in a number of other countries, the Anglo-Saxon municipal system is usedKey characteristics of the Anglo-Saxon model include a clearly codified legal mandate for municipal functions, structural independence from higher levels of government, and jurisdiction over core public services such as policing, social welfare, fire protection, and infrastructure maintenance.The primary distinction between the French (Continental) system and the Anglo-Saxon model lies in the nature of the relationship between local and central government authorities. The French system operates within a framework of centralized governance, where national authorities retain significant oversight over local bodies. This system, formalized by the 1982 French Law "On the Rights and Freedoms of Indigenous Communities," is characterized by the following features:

- The basic local governance unit is the commune, with its leadership elected by the municipal council for a six-year term;
- All adult citizens are granted the right to vote;
- The municipal council is empowered to resolve matters of local significance, except for those under the jurisdiction of the head of the territory;
- Council decisions are binding once submitted to and published by the departmental representative;
- During its inaugural session, the municipal council elects a mayor, who serves as both the head of the commune and chair of the council.
- prepares meetings of the Municipal Council and implements their decisions;
- has the right to manage the property of the commune and make civil transactions;
- represents the interests of the commune in the judicial system;
- appoints employees and decides on administrative incentives and fines;
- manages communal property.

The financial basis of local self-government is rooted in the income generated by local budgets, which represent the core fiscal component within the broader budgetary system. Through established local governance structures and budgetary powers, local authorities implement their financial and legal responsibilities. A significant portion of local budget income originates from tax-based revenues, which constitute their principal source of independent funding.

Based on key indicators for assessing the level of financial decentralization, three models of financial support for local self-government have been identified in global practice.

Table 1 – The share of local taxes in the financial support of local government

Model	Local Taxes as % of GDP	Local Taxes as % of All Taxes	Countries
Scandinavian Model	10-20%	20-50%	Sweden, Denmark, Finland
Latin Model	4-6%	20%	Italy, France, Spain
Hanover Model	1-2%	4-5%	Germany, Poland, Great Britain, Netherlands
Note – compiled by the authors based on source (Wollmann, 2024)			

Many countries face challenges in generating sufficient financial resources to manage the economy and social services through local authorities. This leads to a number of problems:

- The concentration of financial resources in central government budgets, which reduces the role of local budgets in addressing vital tasks for the local population;
- The predominance of regulatory revenues in local budgets, along with a low share of tax payments assigned to the territories;
- The trend of transferring expenditure responsibilities to lower budget levels without providing them with appropriate sources of income, which turns previously self-sufficient local budgets into subsidized budgets.

Local budget management has its own distinct characteristics in different countries, with a long history of development. Taking into account the above-mentioned models of financial support for local self-government, we will examine the formation of local budget revenues in the following countries: Finland (Scandinavian model), France (Latin model), and Germany (Hanover model).

Experience of local government in Finland. Finland consistently ranks among the top countries globally in terms of quality of life and public sector integrity, which suggests a strong correlation between fiscal autonomy at the municipal level and overall governance efficiency.inIn Finland, municipal government is carried out by an executive committee, whose members are elected by the municipal council for a term of four years. The municipal council, which is the highest decision-making body at the local level, also appoints the chairmen of both the council and the executive committee. The executive committee is responsible for implementing the policies and decisions made by the municipal council. The administrative management of the municipality is carried out by a professionally appointed municipal manager, who is elected by the council. This manager, like other municipal employees, retains his or her position regardless of the election results, which ensures stability and impartiality in the municipal administration.

The Municipal Council is the principal governing institution within the municipality. It is composed of elected representatives chosen through local elections held every four years. The number of council members varies from 17 to 85, depending on the size of the municipality's population. Political representation is broad, with all major parties taking part in the local decision-making process.

The council holds the authority to approve the municipal budget and to set local taxes and charges. Local budget revenues in Finland are composed of the following elements:

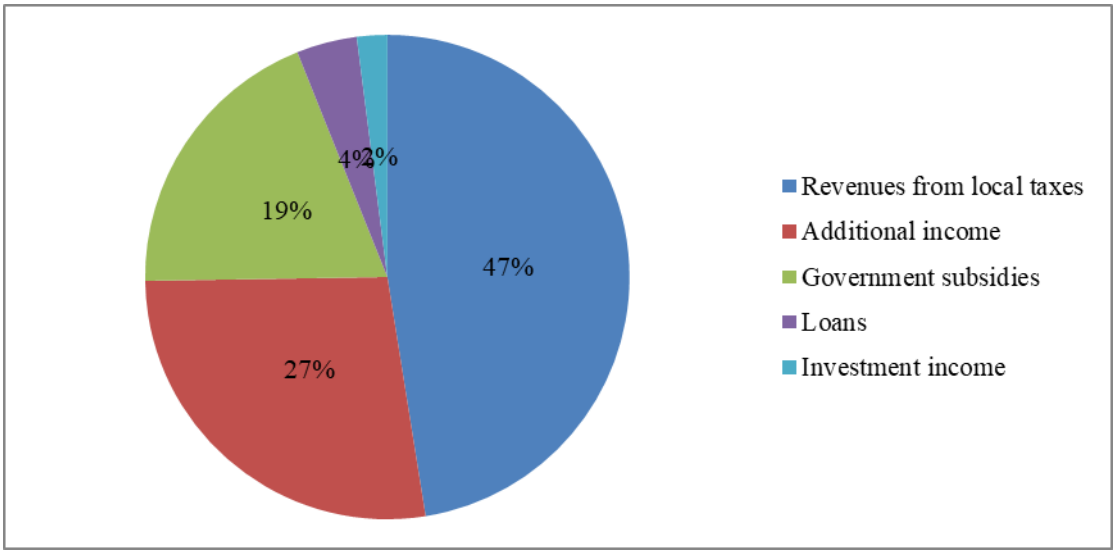

Figure 1 – Composition of Finnish local budget revenues
Note – compiled by the authors based on the source (Rantamäki et al., 2019)

The data illustrates that local budgets are comprised of 47% from local taxes, 27% from supplementary revenues, 19% from state transfers, 4% from borrowed funds, 2% from investment returns, and 1% from miscellaneous sources. The main component of tax-based income is the municipal wage tax, applied to residents' earnings. The tax rate, determined annually by the Municipal Council, typically falls between 15% and 21% (Vakkala, 2021).

State financial assistance is primarily aimed at reducing disparities between affluent and economically weaker municipalities. Wealthier communities are generally excluded from such transfers. Furthermore, municipalities generate additional revenue through service-related charges and fees.

To ensure effective management of the local budget, the Executive Council is complemented by an audit commission and professional auditors. Finland has also developed a special online platform called for presenting civic initiatives. This platform allows citizens to submit written applications to support initiatives or make recommendations. All citizens with the right to vote can present their initiatives through this platform. There are three types of civil initiatives:

1. Propose new legislation;
2. Suggest amendments and additions to existing legislation;
3. Propose the cancellation of current laws.

The system provides online support for all electronic services through individual web platforms. Regular updates are carried out by the relevant government agencies to ensure the system remains functional.

In Finnish municipalities, the Scandinavian type of government is implemented. The local community budget is considered, and the municipality enjoys financial and administrative autonomy. The commune's financial plan is approved each year within the framework of a broader three-year socio-economic strategy and development program. Oversight and preparation of the budget fall under the authority of the Commune Council, which establishes specialized committees to manage specific areas. Members of the council are selected through local elections held every four years. The Executive Committee of the commune serves as the principal administrative and operational authority.

Unlike systems with a designated administrative head, Finnish municipalities operate without a singular chief executive. Instead, the municipal council appoints a professional municipal manager who is responsible for implementing regional development strategies and effectively managing the budget. This manager and his team work on a contract basis, not as civil servants, and continue to perform their duties regardless of the election results, ensuring stability and continuity in municipal governance.

This ensures continuity in the municipality's work (Rantamäki et al., 2019). The commune's budget is formed from the following sources:

Table 2 – Commune budget structures in Finland

Source of Revenue	Percentage of Budget	Description
Local Taxes	47%	Taxes set by the municipal council, which do not require state approval.
Loans	4%	Development-focused loans are exclusively allocated to capital investment initiatives and are never used to cover day-to-day operational expenses. These borrowed funds may originate from either national or international lenders.
State Subsidies	19%	Subsidies to regulate income of communes, pay mandatory public services, and cover expenses.
Additional Income	27%	Income from services like electricity, water, daycare, and nursing home services, transferred from state authorities.
Investment Income & Other Income	3%	Income from property investments and other miscellaneous income.
Note – compiled by the authors based on the source (Slabbinck et al., 2020)		

As we can see from the table in the structure, local taxes take about 47%. Taxes are established by the Council of the commune and do not require approval by state authorities. The councils of the commune can set the types and rates of local taxes – this is a kind of financial independence of the commune. Approximately 4% of municipal budgets are financed through borrowing, which serves as a form of fiscal self-reliance. These loans can come from domestic and international sources, but they are only intended for infrastructure and development projects – not for administrative or current operating costs. Government grants account for 19% of the budget and are intended to equalize income between municipalities, as well as to finance basic public services and tasks. Additional revenues account for about 27% of the local budget and consist of payments for utilities such as electricity and water, preschool education, elderly care and other public services. Most of these services are decentralized to the local level by the central government, allowing local authorities to manage them independently and generate income. Income from investments, including real estate and other assets, accounts for about 3% of total income. Taken together, the overall financial resources controlled by municipalities are comparable in scale to those managed by the national government.

Experience of Local Government in France

France, as a key example of the Latin (continental) model of governance, delegates oversight of local territorial entities to the prefecture, which functions under a centralized system of administrative supervision. In many modern states, local governance structures are increasingly modeled on this framework, where the mayor holds a dual mandate–serving both as the elected leader of the municipal council and as an official representative of the central government within the locality.

The French system uses a three-level subnational structure. The first (higher) level is Regions; the second (central) level is Departments; and the third (lower) level is Municipalities (or communes).

In addition to these three levels, there is an intercommunal level. Local self-government is primarily based on communes. Most communes have small populations (below 2,000). The mayor simultaneously holds powers as both a civil servant and as the head of local self-government under the control of the Municipal Council.

The mayor's powers include managing municipal services, appointing administrative personnel, issuing construction permits, registering civil status acts, ensuring public safety, promulgating state laws and regulations, organizing elections, compiling conscription lists, organizing civil defense, and overseeing primary schools.

In France, territorial associations, which protect the interests of their respective regions, are legal entities of Public Law, and their formation is tied to an independent budget. The council's financial powers include adopting the budget, setting municipal tax rates, managing the purchase, sale, and lease of public property, and developing and approving municipal territorial plans.

France's local taxation framework is composed of five core levies: a residence tax, property tax, construction-related tax, land tax, and the "territorial economic contribution." While municipalities are permitted to set their own tax rates, they are not allowed to define the tax base independently and must comply with boundaries established by the national government.

Financial transfers from the central government to municipalities serve three primary functions: to stabilize local budgets through compensation mechanisms, to promote fiscal equity via equalization payments, and to steer local economic development through targeted incentives. Civic participation in municipal governance extends beyond voting; citizens also engage in advisory boards and local associations. Residents hold the right to propose consultative referendums, which function as tools for gauging public sentiment and ensuring that local decisions reflect community interests (Bouvier, 2021: 5).

France has 36,596 communes, each governed by an elected local council. The number of council members is determined according to the size of the municipality's population. One member is elected mayor and simultaneously acts as both the head of the local council and the representative of the national government. Municipal self-governance in France is constrained by financial and legal limits, as local budgets must be approved by the prefect, the state's appointed representative. Furthermore, communes are only permitted to impose certain indirect taxes, such as waste collection fees.

The typical revenue structure of a French municipal budget is composed as follows: 40% from local taxes, 32% from state grants and subsidies, and 19% from municipal assets and local economic activities.

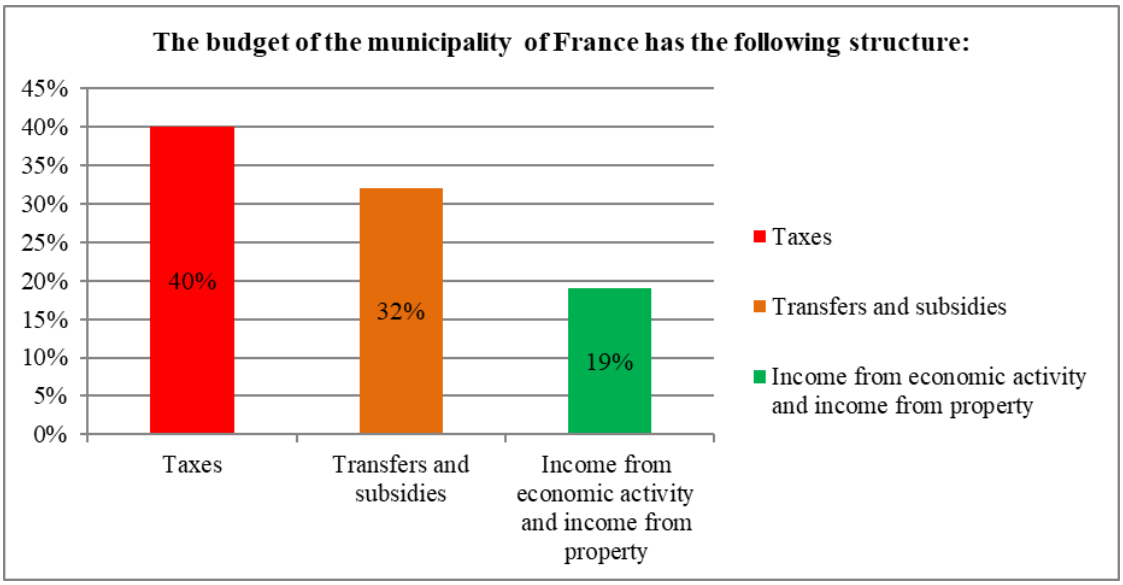

Figure 2 – Revenue composition of the French municipal budget
Note – compiled by the authors based on the (Buv'e, 2011)

Although both Kazakhstan and France are unitary states with strong presidential systems, France's administrative system, particularly its territorial organization and degree of state oversight, closely resembles that of Kazakhstan. However, as a member of the European Union, France has adopted a gradual policy of decentralization aimed at enhancing municipal autonomy and fostering more responsive local governance.

Experience of Local Self-Government in Germany

Germany operates under a three-tier subnational government system, which consists of states, counties, and municipalities. As a federal state, the procedure for appointing heads of local executive bodies varies across the federal states. For instance, in Bavaria, the head of the local executive body is directly elected by the citizens of the municipality. In all regions, the head of the district's executive body is the head of state administration for the respective district.

The leadership of the local administration is typically the **Burgomaster** (the traditional German term), which can be equivalent to the mayor or the head of the commune. Oversight of the legality of decisions made by local authorities is carried out by state administration at the highest level, although some regions establish special control bodies.

In all areas, except for Hesse, municipalities are governed according to a «council system». The local council is elected through a direct vote for a term of four to six years. The mayor, elected through direct universal suffrage, heads the local council and the executive body.

Municipal responsibilities in Germany encompass a wide range of public services, such as the provision of water, heating systems, street lighting, fire protection, urban greening, maintenance of local roads, and the operation of preschools (Wollmann, 2024). The central decision-making body at the municipal level is the council, whose members are elected directly by residents. The length of a council's mandate differs by region – lasting four years in Hesse and six years in Bavaria. The council selects a chairperson from among its own members and also appoints a collective executive authority, known as the magistrate, which is composed of appointed administrative professionals.

Municipal councils are responsible for overseeing a wide range of public services, such as healthcare, education, social welfare programs, waste management, recycling services, and public transportation systems. In addition to collecting local taxes, mainly property and business taxes, local authorities receive financial transfers from the national and regional levels. In order to increase citizen participation, residents' assemblies (Bürgerversammlung) are organized, where residents can formally submit petitions to the municipal council on important issues affecting their community. In order for a petition to be considered, it must be supported by at least 30% of the residents with the right to vote. Ref-

erendums may also be held – either by a two-thirds majority of the council members or on a citizen's initiative if supported by at least 15% of the voters.

Germany's local self-governance functions in accordance with democratic principles, including operational autonomy in local affairs, clear division of competencies between national and municipal levels, and the accountability of local executive authorities for their decisions. A defining aspect of municipal independence in Germany is the right to develop and approve their own budgets. Local authorities are considered fully autonomous only if they possess adequate financial resources and have the legal authority to manage those funds independently. This fiscal autonomy forms the foundation of decentralized decision-making at the local level, signifying genuine financial self-governance (Jochen-Konrad Fromme, 2020: 18).

Although municipalities operate with a degree of independence, they remain under the oversight of state institutions. This supervision encompasses the electoral process, legal regulations, financial management, staffing decisions, and spatial planning. Such a structure enables municipalities to effectively address local challenges and contribute to improving the overall well-being of their residents.

The revenue for the German municipal budget comes from various sources, including municipal taxes, shares of federal and state taxes, income from municipal property, special payments for public institutions, and, in exceptional cases, advance payments in the form of loans and contributions.

Property taxes in Germany are mainly differentiated by type of ownership, such as for residential or commercial purposes. These include land taxes on real estate (types A and B) and occupational taxes related to business activities. Germany also uses a unified tax system for VAT, income tax, and corporate tax, with a certain percentage of the revenue allocated to federal, state, and municipal governments, with each municipality receiving its share.

In Germany and Finland, local government services are divided into three categories: voluntary, compulsory, and commissioned. The latter category includes services that are not strictly local. Currently, compulsory and commissioned services in Germany account for 80-90% of the total cases handled by local authorities.

An interesting aspect of Germany's local self-government experience, particularly relevant for Kazakhstan, is the competitive bidding process for public services like budget publication, procurement, and wholesale goods. This promotes public control over the effectiveness and transparency of municipal budgeting.

Overall, the foreign experience of local self-government underscores the importance of adapting systems to local needs while meeting the expectations of rural populations. Representative bodies exist in all countries under consideration, and in both Germany and Finland, members of these bodies are elected by citizens.

In terms of budgetary decentralization, it is acknowledged as one of the most challenging aspects of decentralization in public power. While the level of fiscal decentralization varies across countries, Finland stands out as a successful example, with its municipalities having significant autonomy in setting tax rates. In Finland, municipalities primarily rely on local income taxes, which constitute roughly 40% of their total revenue, along with a portion of corporate income tax allocations, forming the backbone of their financial resources.

Conclusion

The analysis confirms the hypothesis that adopting selected elements from foreign fiscal models can improve local governance in Kazakhstan. In particular, the Finnish model offers valuable tools for enhancing fiscal autonomy and civic participation. However, institutional, legal, and cultural differences require adaptation rather than direct implementation.

The study contributes to the literature by synthesizing practical elements of foreign models for a post-Soviet context. Limitations include the lack of field data and exclusion of non-European cases. Future research should incorporate quantitative assessments and pilot regional reforms.

For the financial support of local self-government, tax and non-tax revenues play an important role in all of these countries, though non-tax revenues account for a smaller portion of local budget revenues. The list of own income sources varies by country and depends on the ability of local governments to offer paid services. Additionally, the volume of these revenues depends on the extent to which municipalities are provided with municipal property and manage it effectively. In the countries studied, inter-budgetary relations are designed with a simple and transparent structure.

The foundation of tax revenues in these countries is primarily direct taxes. In some cases, where

decentralization of state authority occurs, a portion of indirect taxes is allocated to meet the financial needs of local budgets. Income taxes play an important fiscal and regulatory role, serving as a means of financial equalization between regions. The main tool for local taxation is the real estate tax, which covers buildings and land, alongside the vehicle tax, local taxes, and environmental fees.

Thus, the diversification of revenues for the local autonomous budgets in the studied countries is higher than in Kazakhstan.

Based on the study of trends in the development of systems for the formation of local self-government revenue budgets, the following conclusions can be drawn:

- In Scandinavian model countries, taxation of citizen consumption prevails, and real estate taxation has significant fiscal importance.

- In Latin model countries, taxes on consumption and citizen income are the most important.

- In Hanover model countries, consumption taxation is of less fiscal significance.

For Kazakhstan, it is suggested to establish a representative body based on the German model and adapt it to local powers. France offers a good example of fiscal decentralization. Finland also offers valuable experience in encouraging citizens to participate in budget processes. Among the notable institutional innovations is the establishment of an electronic participatory budgeting portal, which serves as a mechanism for enhancing transparency and citizen engagement in local fiscal decision-making.The model of local self-government in Kazakhstan is based on the experience of France, where the prefect, as a representative of local authorities, makes key decisions and plays an important role in shaping territorial policy.

Empirical evidence from developed nations indicates that administrative decentralization and effective municipal governance are critical drivers of enhanced quality of life and localized socio-economic development. From the point of view of the general political system, local government stands out as the level of government closest to the people.

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BIBLIOMETRIC ANALYSIS OF RESEARCH ON ARTIFICIAL INTELLIGENCE IN ACCOUNTING

This article presents a bibliometric analysis methodology focused on the application of artificial intelligence (AI) in accounting, conducted using international scientific databases such as Scopus, Web of Science, and Google Scholar, along with the VOSviewer analytical tool. The originality of the research lies in the systematization of approaches to the use of AI in automating accounting processes, enhancing the accuracy of financial control, and improving the efficiency of managerial decision-making.

A total of 603 scientific publications were reviewed, with 269 highly cited articles selected from the Scopus database. The results demonstrate a steady increase in interest toward digital technologies in accounting, particularly in the automation of routine operations, digitization of financial reporting, internal auditing, tax accounting, and financial risk forecasting.

Special attention is given to recent trends reflecting the expanding scope of AI in accounting and control. The study concludes by highlighting the potential for further research into the application of AI across various segments of accounting, including a comparative analysis of its impact on accounting efficiency in small and large businesses, as well as the assessment of risks associated with AI implementation in financial systems. Given the limited exploration of accounting digitalization in Kazakhstan, this area offers a promising direction for future academic inquiry.

Keywords: artificial Intelligence, accounting, accounting automation, bibliometric analysis.

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Бухгалтерлік есептегі жасанды интеллектті зерттеулердің библиометрлік талдауы

Бұл мақалада бухгалтерлік есепте жасанды интеллектіні (ЖИ) қолдануға арналған библиометриялық талдау әдістемесі ұсынылады. Зерттеу Scopus, Web of Science және Google Scholar халықаралық ғылыми дерекқорларының негізінде және VOSviewer аналитикалық құралы арқылы жүргізілді. Зерттеудің бірегейлігі – есептік процестерді автоматтандыруда, қаржылық бақылау дәлдігін арттыруда және басқарушылық шешім қабылдау тиімділігін жақсартуда ЖИ-ді қолдану тәсілдерін жүйелеуде болып табылады.

Барлығы 603 ғылыми жарияланым қарастырылып, олардың ішінен Scopus дерекқорындағы дәйексөзі жоғары 269 мақала іріктеліп алынды. Зерттеу нәтижелері бухгалтерлік есеп саласында цифрлық технологияларға деген қызығушылықтың тұрақты түрде артып келе жатқанын көрсетеді. Әсіресе, күнделікті операцияларды автоматтандыру, есептілікті цифрландыру, ішкі аудит, салық есебі және қаржылық тәуекелдерді болжау салалары ерекше назарда.

Соңғы жылдардағы үрдістерге, яғни ЖИ-дің есеп және бақылау жүйелеріндегі қолдану аясының кеңеюіне ерекше көңіл бөлінеді. Қорытынды бөлімде ЖИ-дің бухгалтерлік есептің әртүрлі сегменттеріндегі қолданылуын, оның ішінде шағын және ірі бизнеске әсерін салыстырмалы талдау, сондай-ақ қаржылық жүйелерге енгізуден туындайтын тәуекелдерді бағалау бойынша болашақ зерттеулердің өзектілігі атап өтіледі. Қазақстанда бухгалтерлік есепті цифрландыру деңгейінің жеткіліксіз зерттелуін ескере отырып, бұл бағыт келешегі зор ғылыми бағыт ретінде ұсынылады.

Түйін сөздер: жасанды интеллект, бухгалтерлік есеп, бухгалтерлік есепті автоматтандыру, библиометриялық талдау.

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Библиометрический анализ исследований: искусственный интеллект в бухгалтерском учете

В статье представлена методология библиометрического анализа применения искусственного интеллекта в бухгалтерском учете, выполненного с использованием международных научных баз данных Scopus, Web of Science и Google Scholar, а также аналитического инструмента VOSviewer. Оригинальность исследования заключается в систематизации подходов к использованию ИИ в автоматизации учетных процессов, повышении точности финансового контроля и эффективности управленческого принятия решений.

В рамках анализа было изучено 603 научных публикации, из которых 269 статей с наибольшей цитируемостью были отобраны из базы данных Scopus. Результаты демонстрируют устойчивый рост интереса к цифровым технологиям в бухгалтерии, особенно в сфере автоматизации рутинных операций, цифровизации отчетности, внутреннего аудита, налогового учета и прогнозирования финансовых рисков.

Особое внимание уделяется трендам последних лет, свидетельствующим о расширении тематики ИИ в учете и контроле. В заключении подчеркивается перспективность дальнейших исследований в области применения ИИ в различных сегментах бухгалтерского учета, включая сравнительный анализ эффективности внедрения ИИ в организациях малого и крупного бизнеса, а также изучение рисков цифровизации финансовых систем. Учитывая недостаточный уровень разработанности темы в Республике Казахстан, данное направление представляет собой актуальный научный вектор.

Ключевые слова: искусственный интеллект, бухгалтерский учет, автоматизация бухгалтерского учета, библиометрический анализ.

Introduction

In recent decades, accounting and financial control have undergone significant changes under the influence of digital technologies and artificial intelligence (AI). The development of automated systems, machine learning, and analytical algorithms has led to a significant transformation of traditional accounting processes. The COVID-19 pandemic served as the main catalyst for the industry-wide shift to online platforms. Modern accounting systems are increasingly integrating artificial intelligence (AI) technologies, driven by the desire to automate processes, minimize human errors, and enhance overall work efficiency. According to research findings, this process facilitates the rapid digital transformation of the industry and supports its effective adaptation to emerging technological conditions and innovations. (Altawalbeh & Al Frijat, 2025).

Artificial intelligence (AI) is a rapidly evolving technology with the potential to significantly transform various industries, including the field of accounting. In accounting, AI is being used to improve the efficiency of financial data processing, enhance the accuracy of calculations, automate audit procedures, and detect fraudulent activities. Empirical studies show that the leading global firms – KPMG, PwC, EY, and Deloitte – are actively investing in technological innovation and integrating AI into different aspects of their accounting and auditing operations. (Tandiono, 2023).

To effectively integrate artificial intelligence (AI) into accounting, it is important not only to develop new technologies, but also to assess their impact on the efficiency of accounting processes, the accuracy of financial calculations, and the automation of routine tasks. Currently, in order to increase the efficiency of accounting of economic entities, many of them are actively implementing artificial intelligence in order to reduce costs and reduce the risk of human error. At the same time, the digital transformation of accounting is accompanied by certain requirements. These include cybersecurity issues, as well as the need to train and retrain specialists in new digital tools. In the context of rapid digital progress, there is an increasing need to develop an integrated scientific approach to studying the impact of AI on accounting and control mechanisms of economic entities. The bibliometric analysis of scientific publications on this topic acquires special weight, allowing us to systematize existing research, identify key areas and assess the dynamics of scientific interest.

Despite these global developments, the level of AI adoption and research in Kazakhstan's accounting systems remains limited. According to the Concept for the Development of Artificial Intelligence in the Republic of Kazakhstan for 2024–2029, the government recognizes the importance of AI integration in finance, public services, and education, but practical implementation is still at an early stage (Ministry of Digital Development, 2024). This makes it particularly relevant to examine global research trends and assess Kazakhstan's position within them.

In recent years, the international scientific databases Scopus and Web of Science have recorded a visible increase in the number of publications devoted to the digitalization of accounting of economic entities. This growth shows the increasing attention of researchers to the issues of introducing digital technologies into accounting practice and underlines the relevance of this topic in the scientific community. In this regard, the aim of the present study is to conduct a bibliometric analysis of scientific works dedicated to AI in accounting, to identify key research directions, assess the dynamics of publication activity, and determine the most promising vectors for further development in this field.

Literature review

Alan Turing emerged as one of the pioneering scholars to undertake comprehensive investigations in the domain he termed "machine intelligence." (Turing, 1956). The phrase "artificial intelligence" was initially introduced during the Dartmouth Conference in the year 1956, thereby establishing "Artificial Intelligence Research" as a distinct academic discipline (Russell, 2021), a development attributable to the endeavors of scholars now regarded as the pioneers of this domain: John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon (Kaplan, 2022). Their work laid the foundation for further development of AI research, leading to its active implementation in various areas, including accounting.

Thus, the works of Amelia A. and Baldwin-Morgan emphasize the need for the integration of AI into educational programs in accounting. The authors emphasize that the training of future specialists should take into account the integration of technologies. It is considered how AI can be used for teaching accounting, including in the context of automated data analysis, financial forecasting, and fraud detection. The author notes that technologies such as natural language processing (NLP) and neural network models can help students better analyze financial statements (Baldwin-Morgan, 1995). Similar ideas resonate in the research of White Jr and Clinton E., who consider AI and expert systems as tools for automating logically complex tasks and supporting decision-making in the fields of finance and auditing. They emphasize the importance of using AI where traditional analytical methods prove insufficient (White, 1995). In turn, Duffy (2018) complements this vision by emphasizing the application of machine learning to automate routine tasks, improve reporting accuracy, and free up accountants' time for strategic tasks. Particular attention in the literature is also given to the practical context: in the study by Medyukha E.V. Kovaleva E.A. (2023), it is emphasized that despite the widespread use of software solutions such as 1C, many accounting processes are still carried out manually. The author advocates for the implementation of AI as a means to increase accuracy and reduce labor costs in everyday accounting practices. All the mentioned researchers agree that artificial intelligence is not just an auxiliary tool, but a key technology that transforms both the content and format of an accountant's work – from educational training to practical application in a corporate environment.

The originality of this study is grounded in the examination of scholarly literature pertaining to the utilization of artificial intelligence within the field of accounting. As part of the study, the most relevant and promising directions for the development of AI in this field have been identified, taking into account current trends in the digital transformation of accounting processes. The object of the study is scientific publications registered in the Scopus and Web of Science databases, dedicated to the automation of accounting with the use of AI.

Bibliometric indicators have become the basis for evaluating scientific publications, their impact, and citation rates. The foundations of bibliometrics were laid by Paul Otlet and Samuel Clement Bradford in the early 20th century. However, the key concepts of assessing scientific productivity and citation were developed by Eugene Garfield in the mid-20th century.

Bibliometric indicators serve as a representation of the degree of scientific engagement and efficacy of both theoretical and practical investigations within this domain. This emergent methodology of

quantitative analysis pertaining to the scientific discipline, employed in the exploration of artificial intelligence within the context of accounting, has theoretically elucidated the influence of the most pivotal scientific sources over the preceding quarter-century on the advancement of this field. The practical significance of bibliometric literature assessment lies in the formation of a structured bibliographic database of relevant studies, as well as in the targeted development of scientometric analysis of this topic. The abundance of relevant publications indexed in Scopus, Web of Science, and Google Scholar further validates the topicality and practical relevance of the present study.

Methodology

Within the framework of this research work, a bibliometric analysis of scientific publications related to the use of artificial intelligence in the field of accounting was carried out. The research is aimed at identifying key scientific areas, identifying the most influential authors and publications, as well as analyzing current trends and existing problems in this field. The inquiry included the following stages:

In the context of this research endeavor, a bibliometric examination of scholarly articles focused on the utilization of artificial intelligence within the domain of accounting was performed. The collection of relevant scientific articles was carried out in the international database Scopus, Web of Science, and Google Scholar where the following English keywords were used: “Artificial Intelligence in Accounting,” “Machine Learning in Finance,” “Automation in Accounting,” “AI-based Financial Auditing.” The investigation encompassed a comprehensive examination of scholarly contributions by the foremost experts in the discipline, peer-reviewed journals, and empirical research scrutinizing the effects of artificial intelligence technologies on accounting practices, auditing methodologies, financial data management, and the automation of accounting operations. An examination of article citations from 2000 to 2025 revealed the most significant publications and research trends. During the investigation, 603 papers out of 340 publications were located; 269 of these highly referenced articles were chosen based on subject similarity for further analysis.

At the second stage, for visualizing the obtained data, databases analytics were used, and for keyword analysis, identifying thematic clusters, and constructing bibliometric maps, the software tool VOSviewer was applied. Using this program, a selection of scientific sources was conducted taking into account their authority, significance, and relevance. Special attention was paid to the citation level of the publications and their impact on further research (Bejker, 2014)

The next step was to identify the primary methodological methods and topic directions in the field of AI in accounting by conducting a citation analysis, which is a crucial component of bibliometric research, as well as a content analysis of publications. This methodology demonstrated that it was possible to obtain a comprehensive understanding of the current state of research and form scientifically sound conclusions.

Results and discussion

To ensure methodological transparency, the article selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. Initially, a total of 659,438 documents were retrieved from Scopus, Web of Science, and Google Scholar based on the term “artificial intelligence” in the title, abstract, and keywords. The search was refined to focus on “artificial intelligence in accounting,” resulting in 2,873 articles. The selection process is illustrated in Figure 1, adapted in accordance with PRISMA guidelines.

Although the initially recognized corpus of academic publications appeared to be relevant to the designated topic, a considerable proportion of these works merely engaged with the research question in a constrained manner. In this framework, an exhaustive selection of scholarly literature was conducted, concentrating on those investigations that most comprehensively and directly interact with the research subject, thereby enabling the construction of a literature foundation that aligns precisely with the aims and objectives of the inquiry. As a result, a total of 269 indexed articles were selected, which serve as the foundational basis for the bibliometric analysis and are regarded as the most pertinent to the research theme.

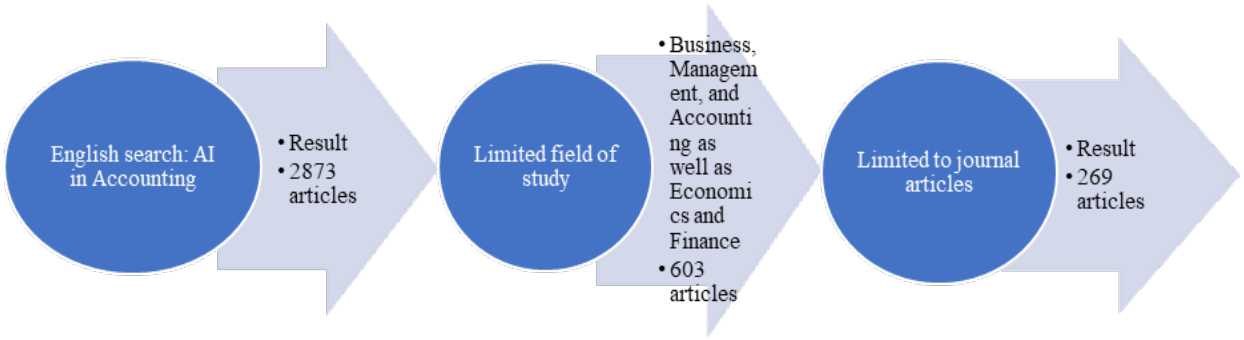

Figure 1 – The process of selecting publications for analysis
Note – compiled by the author based on the source (Scopus, 2025) (electronic resource)

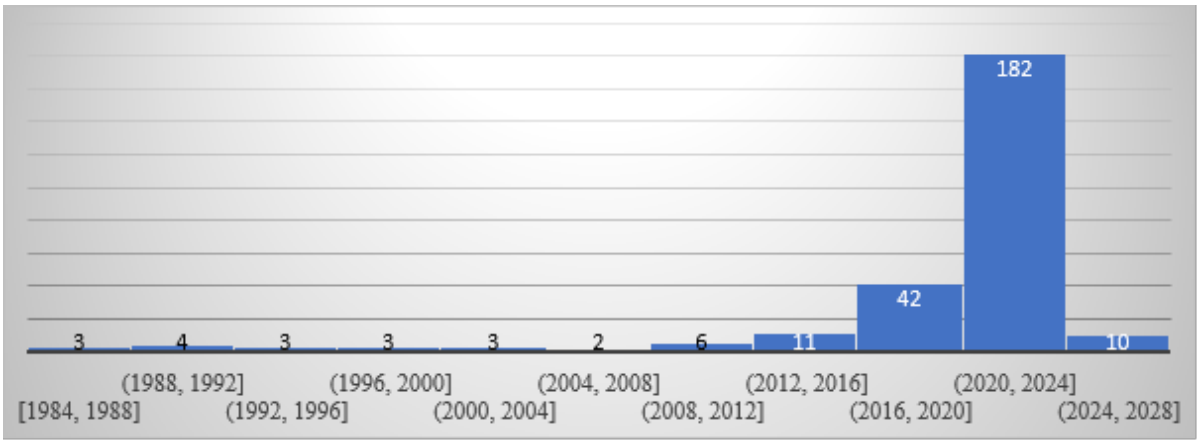

Figure 2 – The quantity of scholarly works pertaining to the domain of artificial intelligence within the field of accounting, spanning the years from 1984 to 2025.
Note – compiled by the author based on the source (Scopus, 2025) (electronic resource)

The diagram shows the number of scientific publications indexed in the database from 1984 to 2028. According to observations, low activity is evident until 2012. During the period from 1984 to 2012, the number of publications remained minimal, ranging from 2 to 6 articles per interval. This indicates a weak interest in the application of AI in accounting during the early stages of digitalization. Starting from 2016-2020, the number of publications significantly increased (42 articles), indicating a rise in the popularity of machine learning and accounting automation technologies. The peak of publication activity falls between 2020 and 2024. Since this period sees a sharp increase in the number of publications, reaching 182 articles, which accounts for more than 50% of all works over the entire analyzed period. This is due to the widespread implementation of AI in accounting systems, the intensification of business digitalization, and the increase in scientific research in this field. Especially the year 2021 became a record year, which may be related to the accelerated digital transformation following the COVID-19 pandemic. During the interval spanning from 2024 to 2028, a notable decline in publication output (10 articles) was observed, which could suggest a transition in scholarly pursuits towards a more pragmatic phase of artificial intelligence integration within accounting methodologies.

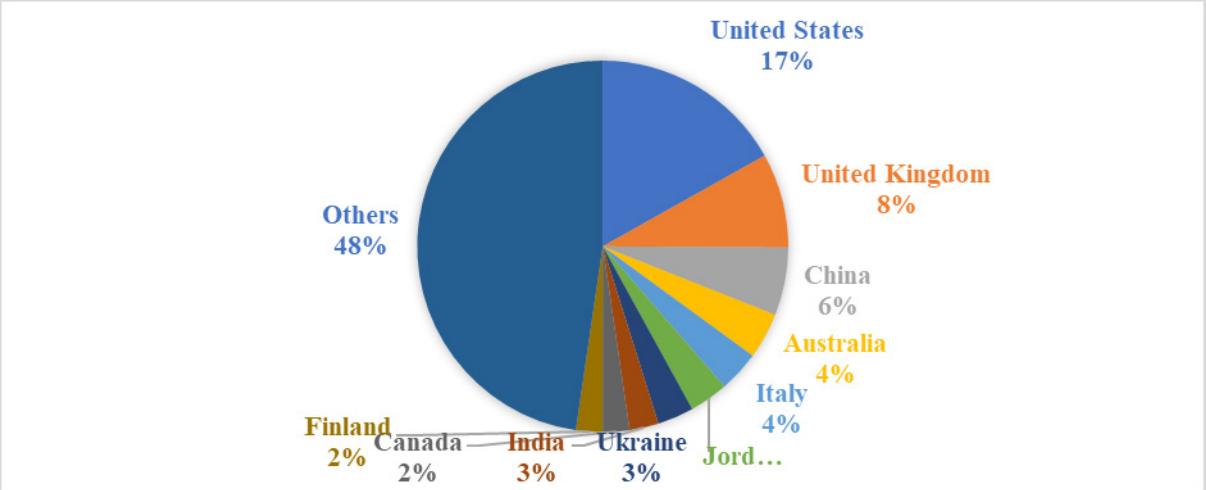

Figure 3 – Proportional representation of scholarly publications by nation for the years 1984 to 2025.
Note – compiled by the author based on the source (Scopus, 2025) (electronic resource)

The highest number of scientific publications is registered in the USA – 17% (80 publications), the leader in the number of studies, which is due to the developed academic environment and the implementation of advanced technologies in accounting systems. Next is the United Kingdom with 8% (39 publications) – one of the leading centers for accounting innovations and financial technologies. China – 6% (28 publications) – a country with active development of AI and its application in various fields of the economy. In contrast, the Republic of Kazakhstan is represented by only three scientific publications indexed in the Scopus database within the scope of this bibliometric analysis. This indicates a relatively low level of scientific output in the field of artificial intelligence in accounting compared to leading countries. However, it also signals the emergence of research interest in this domain:

- Amanova G.D., Akimova B.Zh., Saparbaeva S.S., Moldashbayeva L.P., Zholayeva M.A. (2023). *Problems and prospects in development of digital technologies in accounting and auditing at social enterprises of the Republic of Kazakhstan*. The article analyzes the current state and perspectives of implementing digital tools (AI, Big Data, blockchain, etc.) in Kazakhstan's accounting practices.

- Amirgaliyeva A., Kaliyeva Y., Kadyrova K., Nurpeisova N., Bolshekbaeva K., Beisekova P. (2025). *Identifying areas for improving management accounting tools in the food industry*. This study examines the digital transformation of management accounting in the food sector through ERP systems, AI, and advanced analytical tools.

- Kupalova H., Honcharenko N., Andrusiv U., Jakupova D., Oleshko E., Demchenko K. (2024). *Organizational and financial aspects of distribution management of digital content*. The article explores innovative technologies in digital trade, including artificial intelligence, with co-authorship linked to Kazakhstan. Although not directly focused on accounting, the study reinforces Kazakhstan's contribution to digital and AI-related research.

These publications indicate a nascent but expanding academic presence of Kazakhstan in the global discourse on the digitalization of accounting. The limited number of Scopus-indexed contributions underscores the need to enhance national research capacity and academic visibility in this domain. Overall, the international academic landscape is shaped by contributions published in high-impact journals that focus on financial reporting, auditing practices, and the digital transformation of accounting methodologies (Table 1).

Table 1 – The most significant works published in scientific editions

Journal name	Research areas	Number of publications
Journal of Emerging Technologies in Accounting	The main focus of the publication is the adoption of new technologies in accounting**,** including therole of blockchain and AI in auditing and digital financial services	14
International Journal of Accounting Information Systems	a publication dedicated to the study of information technology in accounting, including the application of artificial intelligence and automated data processing systems	12
Cogent Business And Management	The journal covers a wider range of topics, including the impact of AI on accounting processes, innovative technologies in financial management and digital accounting, as well as the ethical and regulatory aspects of implementing AI in financial and accounting systems.	11
Financial And Credit Activity Problems Of Theory And Practice	This journal focuses on research in finance, credit and accounting.	10
Journal of Risk and Financial Management	an international journal that publishes papers on financial risk management, including research on risk forecasting using AI.	10
Journal Of Accounting And Organizational Change	This journal is dedicated to exploring changes in accounting and organisational processes, Transforming Accounting and Auditing – the impact of digital technology on traditional accounting processes	7
Accounting Research Journal	An authoritative source of accounting research covering digitalisation, auditing and regulatory issues.	2
Journal of Applied Accounting Research	A scholarly, peer-reviewed periodical that disseminates empirical research pertaining to the field of accounting, encompassing the application of artificial intelligence and machine learning in the domain of financial oversight.	4
Meditari Accountancy Research	the dissemination of scholarly work within the domains of accounting, financial oversight, and associated fields, as well as the implications of emergent technologies such as artificial intelligence, machine learning, extensive data analytics, and the mechanization of accounting procedures.	6
Note – compiled by the author based on the source (Scopus, 2025) (electronic resource)		

For the purpose of the analysis, data pertaining to publications cataloged within the Scopus and Web of Science databases were employed. Specifically, the following variables were examined: the annual number of publications spanning from 1984 to 2025, the h-index of 44, the total of 7688 highly cited articles, prominent journals, and prevailing research trajectories.

The examination of the acquired data facilitated a comprehensive evaluation of the progression of scholarly interest in this subject, the recognition of principal research trajectories, and the ascertainment of the influence of artificial intelligence technologies on the advancement of accounting and auditing.

Analysis of publications has shown a steady increase in interest in the topic of AI in accounting since 2020. Prior to this, publications were sporadic; however, since 2021, there has been a sharp increase in the number of works. The highest publication activity is observed in 2023–2024, confirming the relevance of the topic and its demand in the scientific community. The main factors contributing to the growth of interest are:

The number of publications and their citation rates have sharply increased over the past five years, confirming the significance of research in the field of AI and accounting.

Table 3 presents the most significant contributions to the development of scientific research in the application of artificial intelligence in accounting, distinguished by a high level of citation and scientific significance.

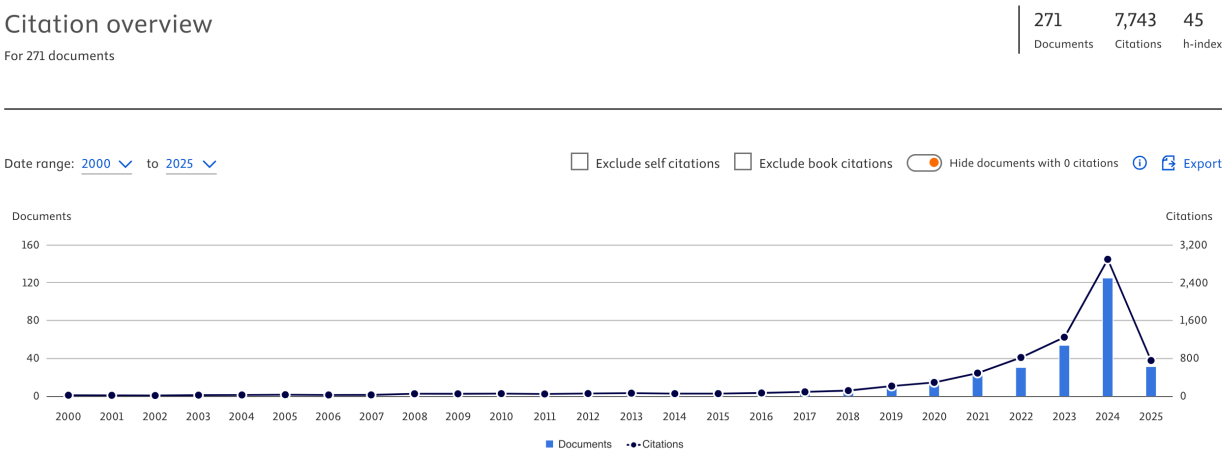

Figure 4 – Dynamics of scholarly publication and citation trends concerning the subject of artificial intelligence within the field of accounting from the years 2000 to 2025
Note – compiled by the author based on the source (Scopus, 2025) (electronic resource)

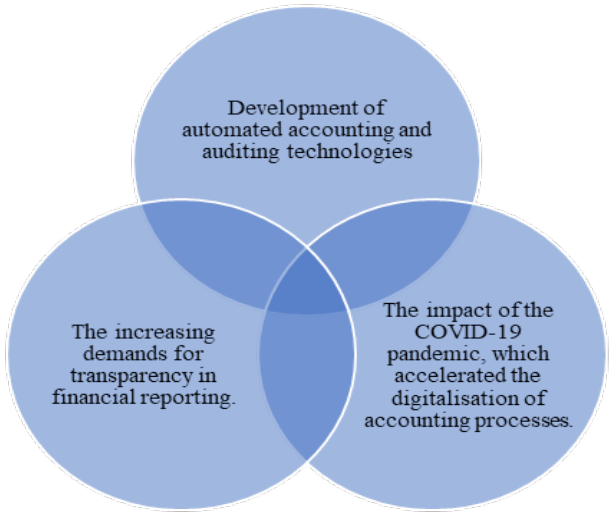

Figure 5 – Factors contributing to the growing interest in artificial intelligence in accounting
Note – compiled by the author based on (Altawalbeh & Al Frijat, 2025).

Table 2 – Key areas of research in AI and accounting

Research area	Key aspects
AI in accounting and reporting	Automated data processing, implications for financial reporting standards.
AI in auditing and regulatory oversight	Audit automation, detection of financial malfeasance
Artificial Intelligence and the Prognostication of Financial Risk	The utilization of data analytics, alongside the advancement of predictive modeling techniques.
Ethical and Regulatory Aspects of AI	Regulation of AI in accounting, explainability of algorithms
AI and automation of accounting processes	Impact of RPA (robotic process automation), digitalisation of accounting, reducing human error
Note – compiled by the author based on the source (Tandiono, 2023)	

Table 3 – A compilation of scholarly articles exhibiting a significant citation rate within the domain of accounting, particularly focusing on the integration of artificial intelligence

Year of publication of the article	Name of article	Journal name	Number of citations
1994	Bankruptcy prediction using neural networks	Decision Support Systems	488
2019	The role of internet-related technologies in shaping the work of accountants: New directions for accounting research	British Accounting Review	328
2017	«The emergence of artificial intelligence: How automation is changing auditing»	Journal of Emerging Technologies in Accounting	303
2017	Revisiting the risk of automation»	Economics Letters	300
2020	«The Ethical Implications of Using Artificial Intelligence in Auditing»	Journal of Business Ethics	245
2023	«Accounting and auditing with blockchain technology and artificial Intelligence: A literature review»	International Journal of Accounting Information Systems	213
2020	«Digital systems and new challenges of financial management – fintech, XBRL, blockchain and cryptocurrencies»	Quality – Access to Success	156
2016	«Natural Language Processing in Accounting, Auditing and Finance: A Synthesis of the Literature with a Roadmap for Future Research»	Intelligent Systems in Accounting, Finance and Management	147
1990	Can software influence creativity?	Information Systems Research	142
2019	A human-centric perspective exploring the readiness towards smart warehousing: The case of a large retail distribution warehouse	International Journal of Information Management	139
2016	"The reports of my death are greatly exaggerated"—Artificial intelligence research in accounting	International Journal of Accounting Information Systems	138
2020	Sustainability accounting and reporting in the industry 4.0	Journal of Cleaner Production	130
2021	Mediating effect of use perceptions on technology readiness and adoption of artificial intelligence in accounting	Accounting Education	127
2020	Blockchain technology, business data analytics, and artificial intelligence: Use in the accounting profession and ideas for inclusion into the accounting curriculum	Journal of Emerging Technologies in Accounting	123
2023	An artificial intelligence algorithmic approach to ethical decision-making in human resource management processes	Human Resource Management Review	119
Note – compiled by the author based on the source (Scopus, 2025) (electronic resource)			

In the course of conducting an analysis of bibliometric data, the preeminent scientific articles that have garnered the highest citation counts and are published in prestigious academic journals focusing on the implementation of artificial intelligence (AI) within the realm of accounting were discerned. To ensure the academic quality of the analyzed corpus, we introduced a citation threshold criterion. Based on the distribution of citation counts among the selected 269 articles, we established that the 90th percentile equals 428 citations. Therefore, publications cited ≥ 428 times were considered highly influential. One prominent example is the article "Bankruptcy prediction using neural networks", which had 488 citations at the time of the analysis, placing it among the top 10% of the most cited studies in the field.

Through the process of citation analysis, a total of 15 publications of considerable significance that have exerted a profound influence on the advancement of this scholarly domain were identified. However, in addition to these works, the study also considered other articles covering related topics. Among the first 15 works included in the review, the following key research directions stand out – Bankruptcy prediction using neural networks – a 1994 paper (488 citations) represents an early study demonstrating the application of machine learning methods in financial forecasting (Wilson, 1994).

«The role of internet-related technologies in shaping the work of accountants: New directions for accounting research», (2019, 328 citations) – the article analyzes the impact of digital technologies on the accounting profession (Moll, 2019).

«The impact of automation and AI on auditing (The emergence of artificial intelligence: How automation is changing auditing», (2017, 303 citations) – the work examines how automation affects auditing (Kokina, 2017).

«Risks of Automation and Impact on the Labor Market (Revisiting the risk of automation, 2017, 300 citations) – the study examines the economic consequences of implementing automated technologies in accounting (Arntz, 2017).

«Ethical Implications of Using Artificial Intelligence in Auditing» (2020, 245 citations) – the focus is on the ethical challenges associated with the automation of auditing processes (Munoko, 2020).

«The use of blockchain and AI in accounting and auditing» (Accounting and auditing with blockchain technology and artificial intelligence: A literature review, 2023, 213 citations) – the study systematizes the main directions of integrating blockchain and AI into the accounting field (Han, 2023).

The analysis of the citation of scientific publications showed that the most significant influence on the development of the topic was exerted by works dedicated to audit automation, bankruptcy prediction, the use of blockchain, and machine learning in accounting. The publications that receive the highest frequency of citations are those disseminated in esteemed international academic journals, including the "Journal of Emerging Technologies in Accounting," the "International Journal of Accounting Information Systems," and the "British Accounting Review."

Keywords play an important role in representing research topics. This visualization is a bibliometric map reflecting the relationships between keywords used in scientific publications on the topic of artificial intelligence (AI) in accounting. The main clusters of keywords are marked in different colors, allowing for the identification of several interconnected research directions.

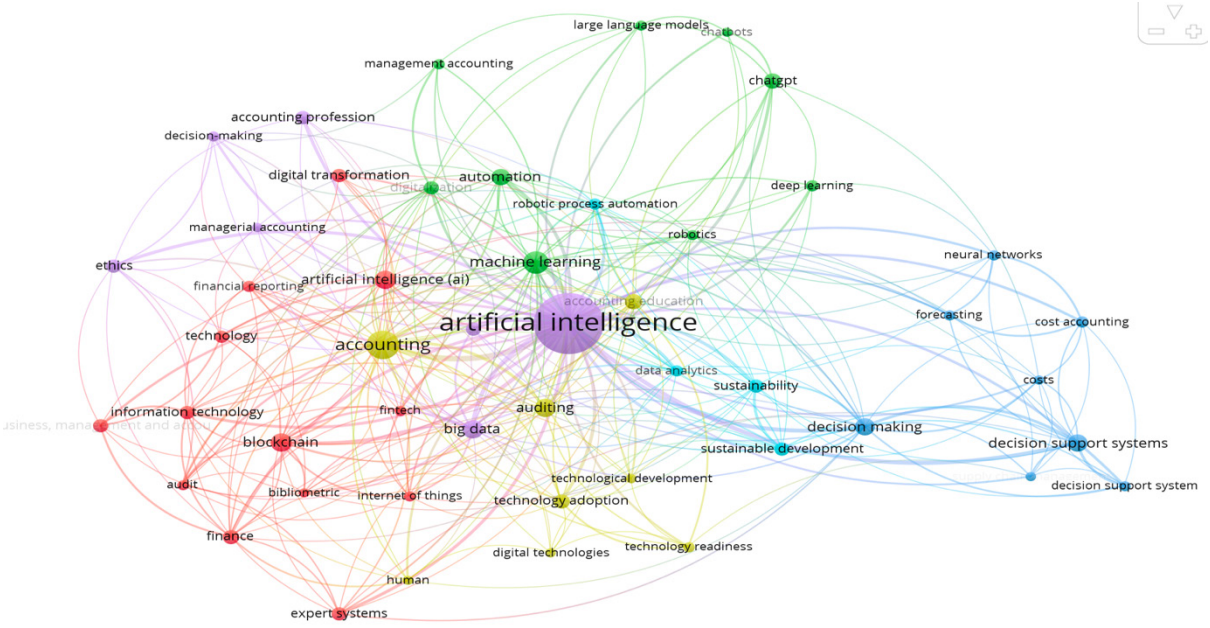

Figure 6 – Bibliometric map of key research areas on artificial intelligence in accounting.
Note – compiled by the author using VOSviewer 2025

The primary cluster (illustrated in purple) encompasses the domains of "Artificial Intelligence" and "Accounting." This section depicts a key aspect of the research discipline, which focuses on the use of artificial intelligence in the fields of accounting, auditing, and big data processing. It covers aspects such as financial reporting and the evolution of digital transformation.

Red cluster – "Blockchain, Fintech, and Information Technology". Research in this cluster focuses on the integration of blockchain technology, financial innovations (fintech), and artificial intelligence in the field of accounting. Blockchain is viewed as a tool that enhances transparency, strengthens data security, and supports the automation of accounting processes, thereby contributing to the modernization and reliability of financial reporting systems. Special emphasis is placed on digital financial technologies (FinTech) and their consequential applications within the accounting sector.

Blue cluster – "Problem Solving and Forecasting" Keywords: decision support systems, decision making, cost accounting, forecasting, neural networks. In this cluster, the research focuses on the application of decision support systems (DSS) and machine learning for data analysis and forecasting. Attention is given to network technologies (neural networks) and their impact on the automation of managerial decisions.

Green cluster – "Machine Learning and Automation" Keywords: machine learning, deep learning, chatbots, large language models, automation, robotic process automation. Monitoring in this part focuses on analyzing the possibilities of using deep learning technologies and automated accounting systems in order to increase the efficiency and optimize accounting processes of accounting systems. Special attention is paid to the implementation of ERP systems, which makes it possible to transform modern accounting and auditing practices, helping to reduce time costs, increase the accuracy of operations and reduce the risk of human error.

Yellow cluster – "Technological Transformation of Accounting" Keywords: technological development, technology adoption, technology readiness, sustainability, digital transformation

Purple block – "Ethics, management and professional accounting" Keywords: ethics, digital transformation, decision-making, accounting profession, managerial accounting. This block reflects the complexities associated with ethics, decision-making processes, and managerial accounting. The ramifications of artificial intelligence on the field of professional accounting, alongside the evolving responsibilities of accountants within the digital economic landscape, are currently under scholarly review.

Thus, AI in accounting is actively researched in the context of blockchain, fintech, forecasting, automation, and decision-making. Where the most popular areas are – the use of machine learning and automation for data processing. Blockchain and digital technologies for accounting transparency. Ethics and managerial decisions in the context of digital transformation. The interconnection of AI with Big Data, neural networks, chatbots, and financial technologies indicates a comprehensive approach to researching this topic.

Overall, the keyword map demonstrates the interdisciplinary nature of the research and the active development of the field at the intersection of accounting, artificial intelligence, fintech, and digital transformation.

Discussion

The analysis of existing research on the application of artificial intelligence in accounting allows for agreement with the position of the majority of authors presented in the conducted bibliometric review. The bibliometric analysis confirms that artificial intelligence plays a fundamental and multifaceted role in the evolution of accounting. AI not only automates repetitive processes such as data entry, reconciliation, and report generation, but also enhances the analytical capacity of accountants through predictive modeling, real-time insights, and anomaly detection. It contributes to more informed decision-making, strengthens internal controls, and supports the strategic functions of financial management. Overall, AI emerges as a catalyst for the transition from traditional bookkeeping to data-driven, forward-looking accounting practices. In particular, the works of Baldwin-Morgan, White Jr., Duffy, Andyk, and other authoritative researchers confirm that AI is becoming an integral tool in the transformation of the accounting environment. Their works demonstrate a high degree of consensus regarding the benefits of AI implementation: from automating routine tasks and improving reporting accuracy to expanding accountants' analytical capabilities.

Although the bibliometric review covered a global sample of publications indexed in Scopus, only three scientific articles affiliated with Kazakhstan were identified within the scope of this analysis. This indicates a relatively low level of academic productivity in the field of artificial intelligence in

accounting from Kazakhstan compared to leading countries such as the United States, the United Kingdom, or China.

From a scholarly standpoint, this underrepresentation highlights a structural limitation in the regional research output and signals the need for enhanced academic support, research funding, and international collaboration in Kazakhstan. The identified publications, although few, demonstrate an emerging academic interest in the digitalization of accounting and the application of AI technologies. Future studies should aim to increase both the quantity and the depth of research to ensure broader participation in the global discourse on accounting innovation.

Nevertheless, it should be noted that a significant portion of publications is predominantly focused on the technical aspects of AI implementation or its applied capabilities in large corporations. Less attention is given to the specifics of accounting digitalization in developing countries, including Kazakhstan, where transformation processes are just gaining momentum. The lack of comprehensive cross-industry comparative studies, as well as works dedicated to assessing risks and regulatory-ethical barriers in local markets, limits the completeness of understanding the global impact of AI.

From a scientific perspective, this study fills a gap by incorporating bibliometric analysis with consideration of regional specifics and an emphasis on the need to adapt AI in the context of national accounting systems. It is proposed to further strengthen interdisciplinary research focused on combining AI with managerial accounting, environmental auditing, and corporate sustainability. Additionally, it is recommended to develop thematic studies in the field of education – for example, on the implementation of AI in accounting training programs, which will help form a new generation of specialists ready to work in a digital environment.

Thus, the novelty of the present study lies not only in the systematization of scientific publications but also in the formation of well-founded directions for future academic and practice-oriented research in the field of AI and accounting.

Conclusion

The current investigation has demonstrated a notable surge in interest surrounding the utilization of artificial intelligence within the domain of accounting, driven by advancements in digital technologies, the growing volume of financial data, and the need to automate accounting functions and improve the precision of financial reporting. The increasing competition in the accounting field requires the use of AI methods to enhance data analysis quality, minimize errors, and better meet the information needs of various stakeholders.

An analysis of a sample of 603 articles, from which 269 highly cited articles were selected from the Scopus database, showed a high evaluation of publication activity and scientific trends on the topic of artificial intelligence (AI) applications in accounting. The study is based on data from the international Scopus database and covers the period from 1984 to 2025. The analysis of publications showed that the active growth of interest in the application of AI in accounting began in 2016. The significant increase in scientific activity occurred in 2021, when the highest number of articles was published. In the period from 2020 to 2024, the number of publications sharply increased, indicating an intensified scientific interest in the digitalization of accounting. The largest number of studies was registered in the USA (17%), which can be attributed to the developed academic environment and the implementation of AI in accounting systems. The United Kingdom (8%) and China (6%) also hold leading positions in research on this topic. Kazakhstan is represented by 3 publications, which is still a relatively low figure, but indicates the beginning of the country's active involvement in the study of AI in accounting. The leading scientific journals in this field are: Journal of Emerging Technologies in Accounting, International Journal of Accounting Information Systems, British Accounting Review, Journal of Business Ethics. The results of the study confirm the growing significance of artificial intelligence technologies in accounting. The analysis of scientific publications identified the main research directions, key development vectors, and promising areas of AI application in this field. Consequently, the bibliometric examination of the literature substantiated that artificial intelligence assumes an ever more significant function within the field of accounting, and its implementation necessitates additional investigation from both technological and ethical standpoints.

Going forward, it is recommended to pursue more practice-oriented research, focusing on the integration of AI tools into corporate accounting frameworks and national financial systems. Special emphasis should also be placed on the modernization of accounting education, including AI-related content and collaboration with industry practitioners.

Importantly, the present study was limited to the global academic landscape. Future research will aim to conduct a deep content analysis of Kazakhstani scholarly journals indexed in the Committee for Quality Assurance in Science and Higher Education (ККСНВО), in order to map national scientific trends and assess the domestic potential for developing AI-driven accounting practices. This will allow for a more comprehensive understanding of Kazakhstan's academic capacity and help identify opportunities to align national research with global trends in accounting innovation.

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PROMOTING INTEGRITY IN THE CIVIL SERVICE: ECONOMIC, LEGAL AND SOCIAL ASPECTS IN THE CONTEXT OF THE REPUBLIC OF KAZAKHSTAN

This article examines the concept of integrity in the civil service, its significance, and approaches to its development, with a particular emphasis on the economic dimensions and the impact of integrity on the efficiency of public administration. Theoretical foundations for strengthening the principle of integrity in the civil service are analyzed, with a focus on mechanisms for its institutionalization within the public governance system of the Republic of Kazakhstan.

Special attention is given to the role of a performance-based remuneration system, particularly one founded on a factor-point evaluation of civil servants, as an economic incentive for ethical behavior and improved productivity in the civil service. The article includes a comparative analysis of international experiences – specifically those of the Kingdom of Denmark and the People's Republic of China – in shaping integrity systems through economically grounded approaches, identifying lessons applicable to Kazakhstan's national context.

Furthermore, the research explores the importance of ethical standards, transparency, and accountability in fostering institutional trust, alongside an assessment of the economic benefits of reducing corruption risks through digitalization and the implementation of e-government tools. In addition to traditional measures such as criminal prosecution, education, training, and audits, the author proposes the promotion of integrity through incentive-based mechanisms as an effective means of embedding integrity ideology in the civil service.

The findings contribute to the broader discourse on the economic effectiveness of anti-corruption strategies and highlight the strategic relevance of promoting integrity within a sustainable and results-oriented public administration framework.

Keywords: corruption, economic impact, public service, integrity, corruption prevention, anti-corruption policy.

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Мемлекеттік қызметтегі парасаттылықты ілгерілету: Қазақстан Республикасы тәжірибесіндегі экономикалық, құқықтық және әлеуметтік аспектілер

Бұл мақалада мемлекеттік қызметтегі адалдық ұғымы, оның маңызы және оны дамыту тәсілдері қарастырылады, сонымен қатар адалдықтың мемлекеттік басқару тиімділігіне әсер ететін экономикалық қырларына ерекше назар аударылады. Мемлекеттік қызметтегі адалдық қағидатын нығайтудың теориялық негіздері талданып, оны Қазақстан Республикасының мемлекеттік басқару жүйесіне енгізудің тетіктері сараланады.

Адал мінез-құлық пен мемлекеттік қызметтегі өнімділікті арттыруға бағытталған факторлы-баллдық бағалау жүйесіне негізделген марапаттау жүйесі адалдықты қаржылық ынталандыру құралы ретінде жеке қарастырылады. Сонымен қатар, мақалада Дания Корольдігі мен Қытай Халық Республикасының мемлекеттік басқару жүйесінде адалдық институтын экономикалық негізде қалыптастыру тәжірибесіне салыстырмалы талдау жасалып, Қазақстан үшін өзекті элементтер анықталады.

Зерттеуде этикалық нормалар, ашықтық пен есептілік сияқты факторлардың институционалдық сенімді арттырудағы маңызы ашылып көрсетіледі, сондай-ақ цифрландыру мен электрондық үкімет құралдарын енгізу арқылы жемқорлық тәуекелдерін азайтудың экономикалық тиімділігі бағаланады. Қылмыстық қудалау, білім беру, оқыту және тексерулер сияқты дәстүрлі шаралармен қатар, автор мемлекеттік қызметшілер арасында адалдықты қаржылық ынталандыру жүйесі арқылы ілгерілетуді адалдық идеологиясын орнықтырудың тиімді тәсілі ретінде ұсынады.

Алынған нәтижелер сыбайлас жемқорлыққа қарсы стратегиялардың экономикалық тиімділігіне қатысты ғылыми пікірталасты тереңдете түсіп, орнықты әрі нәтижеге бағытталған мемлекеттік қызмет шеңберінде адалдықты дамытудың стратегиялық маңызын көрсетеді.

Түйін сөздер: сыбайлас жемқорлық, экономикалық әсер, мемлекеттік қызмет, парасаттылық, сыбайлас жемқорлық превенциясы, сыбайлас жемқорлыққа қарсы саясат.

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Продвижение добропорядочности в государственной службе: экономические, правовые и социальные аспекты в контексте Республики Казахстан

В статье рассматривается понятие добропорядочности в государственной службе, ее значение и подходы к развитию, с особым акцентом на экономические аспекты и влияние института добропорядочности на эффективность государственного управления. Анализируются теоретические основы укрепления принципа добропорядочности в государственной службе, при этом особое внимание уделяется механизмам его институционализации в управленческой системе Республики Казахстан. Важное место занимает анализ системы вознаграждения, основанной на факторно-бальной оценке должностных лиц, как инструмента экономического стимулирования этичного поведения и повышения производительности в государственной службе.

В статье также проводится сравнительный анализ зарубежного опыта, в частности Королевства Дания и Китайской Народной Республики, в сфере экономически обоснованного формирования института добропорядочности, с выявлением применимых элементов для национального контекста. Оценивается роль этических норм, прозрачности и подотчетности в повышении институционального доверия, а также рассматриваются экономические выгоды от снижения коррупционных рисков за счёт внедрения цифровых технологий и электронного государственного управления.

Автор предлагает дополнить традиционные меры (уголовное преследование, образование, обучение, проверки) экономически мотивированной системой поощрения добропорядочного поведения как действенным элементом реформ. Сделанные выводы способствуют углублению понимания экономической эффективности антикоррупционных стратегий и подчеркивают значимость развития добропорядочности в рамках устойчивой и продуктивной государственной службы.

Ключевые слова: коррупция, экономическое воздействие, государственная служба, добропорядочность, превенция коррупции, антикоррупционная политика.

Introduction

To reduce instances of corruption within public administration institutions, fostering an atmosphere of zero tolerance toward any form of misconduct through the concept of integrity has become one of the key mechanisms in anti-corruption policy.

The concept of integrity in public administration has several definitions. According to the United Nations Committee of Experts on Public Administration, this term is associated with "the honesty of public servants in the fulfillment of their duties" (UN Office on Drugs and Crime, 2005). The Organisation for Economic Co-operation and Development (OECD) defines integrity as "the protection of public interest over private interest and the observance of universally recognized ethical values" (Organisation for Economic Co-operation and Development, 2022). Similarly, the World Trade Organization (WTO) explains it as "adherence to fundamental behavioral standards, ensuring that personal interests do not conflict with the common good" (World Trade Orgaization, 2024).

The fundamental principle for establishing an effective public administration is the cultivation of integrity among employees in both state and quasi-state institutions. An integrity-driven employee is one who prioritizes ethics, high cultural standards, and a complete intolerance towards corruption in their work (Smailova, 2023).

The concept of integrity is associated with notions of fairness and honesty in the legislation of the Republic of Kazakhstan, sharing a legal similarity with these terms (Civil Code Of The Republic Of Kazakhstan, 1994).

The scope of the concept of integrity is broad and is not limited to interpersonal relationships; it also encompasses adherence to written laws and

norms. Integrity means making decisions that do not contravene the law and common ethical standards, even when no one is watching, and living by those decisions.

In the fight against corruption and its prevention, the term "integrity" has been incorporated into normative legal acts since 2022. This is evident from the "Concept of Anti-Corruption Policy of the Republic of Kazakhstan for 2022-2026," approved by Presidential Decree No. 802 on February 2, 2022. In this concept, the term "integrity" is mentioned 11 times. Prior to this, the term had not been used in legislative acts as a mechanism against corruption.

Through dialectical analysis, the term "integrity" in public administration refers to upholding general ethical standards while prioritizing the interests of society and the state above personal interests and maintaining honesty.

In public and quasi-public service worldwide, there are numerous high standards of integrity, codes of ethics, and lists of overarching values and their explanations. However, there is often limited attention given to how these norms should be applied in specific situations (Rasulov & Otanazarov, 2023).

The preservation of these values is viewed as a contributing factor to reducing corruption, prompting a series of measures to be implemented by the authority responsible for anti-corruption policy in the Republic of Kazakhstan. However, the lack of a comprehensive and consistent list of specific anti-corruption measures hinders the evaluation of the results achieved.

The preventive measures enforced by supervisory and oversight governmental bodies, including audits, monitoring, and restrictions, can be perceived by public servants as pressure. This creates additional challenges such as heightened anxiety, stress outside of work, and a constant state of apprehension, leading to a lack of motivation at work.

Despite the abundance of theoretical materials on this topic, they often fail to illuminate the concept of integrity in our public service context. This is primarily due to the fact that global academic centers do not consider the cultural, social, economic, and legal foundations of our country.

The purpose of this article is to highlight the necessity of establishing an environment of integrity in public service – not merely through warnings, intimidation, audits, and monitoring – but by motivating public servants toward a bright future and fostering a belief in working together for a common goal.

Literature review

The development of an ideology of integrity in public service implies strict adherence to ethical standards by officials. It is evident that in an environment where ethical behavior is well-established, it becomes easier to implement a zero-tolerance principle towards corruption.

Corruption is the unethical and dishonest behavior of an official aimed at personal gain (Stapenhurst & Kpundeh, 1998).

According to the research of Russian economist L.I. Melamedov, the key principle in combating corruption is the promotion of transparency and ethical standards (Melamedov, 2017).

According to British sociologist Baron Anthony Giddens, it is impossible to constantly monitor corruption risks in a way that completely prevents them. Oversight by the state or management cannot entirely eliminate corruption risks, as the factors that create conditions for corruption are continuously evolving. Additionally, instances of corruption occur as a result of complex social relationships (Giddens, 2004).

Robert Klitgaard, a political scientist known for his corruption formula, emphasized that governmental corruption not only undermines governance but also intensifies economic inequality by distorting resource allocation and weakening public trust in institutions. He argued that corruption leads to a disproportionate concentration of wealth and power, as low-income citizens face systemic barriers to accessing public goods, social services, and economic opportunities, while corrupt elites redirect public resources for private gain. This misallocation of funds and erosion of fiscal integrity, Klitgaard noted, ultimately hinders economic growth, deters investment, and deepens poverty among the most vulnerable segments of society (Klitgaard, 2008).

Alina Rocha Menocal, in her academic writings, asserts that corruption erodes the institutional bedrock essential for lasting development and adversely impacts both societal stability and democratic systems. She stresses that corruption impedes effective governance, intensifies inequality, and curtails citizens' chances to engage in decision-making processes (Menocal, 2024).

In his economic analyses, Adam Smith examined how corruption affects economic development. He illustrates in his writings that corruption results in reduced investment, a decline in the quality of public services, and a deceleration of economic

growth, especially in nations with developing economies (Gerald, 1979).

Richard Tayler, an economics professor, investigated the influence of corruption on social inequality and the effectiveness of public governance. His research highlights how corruption can impede the progress of democracy and erode public confidence in government bodies (Taylor, 2017).

Roger Garrison examined how corruption contributes to diminished economic efficiency and the expansion of the informal economy. Their findings suggest that corruption results in the ineffective allocation of resources and hinders sustained long-term economic growth (Garrison, 2001).

Daron Acemoglu, an economist and co-author of Why Nations Fail, investigated how corruption influences the economic development of India and China. His analysis indicated a correlation between high levels of corruption and decelerated economic growth. He observed that when governments are prone to corruption, investment in crucial areas such as infrastructure and education declines, which negatively impacts long-term development prospects (Acemoglu, 2020).

In her publication, "Corruption in Public Procurement: Causes, Consequences, and Cures," Tina Søreide investigates corruption within the process of acquiring goods and services.While primarily centered on bureaucratic management, her analysis also considers the political implications. Søreide delves into three main facets of procurement-related corruption: first, the challenges stemming from its pervasive nature; second, the methods employed in this illicit activity; and third, practical approaches to combating it.She particularly emphasizes accountability and the regulation of private firms, stressing the critical role of political commitment for effective reform implementation (Søreide, 2002).

According to researchers, reducing instances of corruption is not limited to addressing gaps in legislation; corruption must also be viewed as a social phenomenon. The internal conscience and integrity of public officials, when they are given decision-making power, cannot always be monitored by state bodies or leadership.

The impact of environments with low integrity and a propensity for corruption has led to the decline and loss of statehood of several empires and powerful nations throughout history (Kazpravda, 2019).

Therefore, corruption not only impacts the economic and social conditions of the state but also represents a significant obstacle to the bright future of the entire nation.

In the normative legal acts of the Republic of Kazakhstan, corruption is considered one of the main factors threatening the national security of the country, alongside terrorism (On national security of the Republic of Kazakhstan, 2012).

"As has been established through centuries of experience, every individual in a position of power is inclined to misuse it and will continue to do so until they reach the limits set for themselves" (Montesquieu, 1748).

Methodology

The enhancement of the principles of integrity in public service further professionalizes the government apparatus. It facilitates the relationship between the government institutions and society, thereby increasing public trust in state authority.

The empirical basis of the research is content analysis. Given the substantial volume of information analyzed by the author and the fact that this information consists of official state documents, this research method was selected.

The normative legal framework includes the Constitution of the Republic of Kazakhstan, the Laws of the Republic of Kazakhstan, and decrees of the Government of the Republic of Kazakhstan.

The research examines the relationship between the acceptance of the normative legal framework and the widespread dissemination of the ideology of integrity among public servants. Content analysis was conducted using information exclusively from official documents (Avdeeva, 2015).

Content analysis was employed as the primary method of this research, and to validate the analyzed information, a supplementary comparative method will be utilized (Okhotnikova, 2019).

The comparative method of the research is an effective and comprehensive approach that aids in understanding and describing political processes and changes in any country. It allows for a deeper understanding of the situation by taking into account the real conditions faced by the political system, as well as the concepts and objectives involved (Simanovskiy, 2002).

The comparative research method will compare the Kazakhstani experience with the Danish practices in promoting integrity.

For the purposes of this research, the author analyzes the experience of Denmark in promoting integrity, which has ranked first for the past two years in the analysis conducted by the international non-governmental organization "Transparency Interna-

tional" in the areas of anti-corruption and the promotion of integrity, achieving the highest success in this regard (Transparency International , 2024).

In the Republic of Kazakhstan, several legislative acts are in place to promote integrity within state authority and executive institutions. The main ones include the Laws "On Public Service of the Republic of Kazakhstan," "On Counteracting Corruption," and the Presidential Decree "On Measures for Further Improvement of the Ethical Norms and Behavioral Principles of Public Servants."

Additionally, there are rules developed in accordance with the Constitution of the Republic of Kazakhstan and the aforementioned laws. There are over 20 supervisory and regulatory bodies in the country that verify, monitor, and analyze the adherence of public servants to the principles of integrity in their daily duties, as well as the accuracy and legality of their decisions and reports.

Moreover, the off-duty lives of public servants are under the scrutiny and oversight of society, particularly from active members of the community.

Results and discussion

The authorized body in the fight against corruption in our country is the Anti-Corruption Agency of the Republic of Kazakhstan, which is currently conducting comprehensive preventive measures aimed at promoting the ideology of integrity and mitigating corruption risks. The main activities include external and internal analysis of corruption risks, corruption monitoring, educational efforts to establish a culture of zero tolerance towards corruption, anti-corruption restrictions, research on anti-corruption measures in legislation, dismissal practices for employees proven to have committed corruption offenses, compliance services in the quasi-public sector, and reward practices for individuals reporting corruption offenses.

Additionally, the recently introduced "Integrity Check" project allows for the assessment of a public servant's propensity for misconduct by artificially simulating corruption situations in accordance with legal procedures.

Furthermore, there are currently proposed amendments and additions to existing anti-corruption legislation that have emerged for public discussion. These amendments will also include criminal liability for agreements and promises related to corruption offenses.

Based on the above, significant contributions are being made to reduce instances of bribery among public servants through restrictive and verification procedures.

However, the pressure exerted on public servants, coupled with excessive worries, stress outside of work, constant anxiety, and lack of motivation, undoubtedly creates challenging conditions for their work (Mayo Clinic Staff, 2023).

In this context, the work "Disneyland with Death Penalty" by American author William Gibson comes to mind. In the narrative, the strict laws of Singapore are depicted, highlighting how the severity of the law transforms people into a uniform, unreflective gray mass. The author presents evidence that in recent years, the creative industry in this country is on the brink of decline, along with the deterioration of arts and culture (Gibson, 1993).

In conclusion, comprehensive oversight and excessive restrictions undoubtedly hinder public servants from thinking creatively and making bold decisions.

In 2022, the authorized body of the Republic of Kazakhstan reported 1,724 instances of corruption, resulting in the conviction of 725 individuals. As a result of these measures, a total of 109 billion tenge was recovered and returned to the state budget (National Anti-Corruption Report 2022, 2023).

In 2023, 1,692 crimes were recorded, and 916 individuals were found guilty by court decision (National Anti-Corruption Report 2023, 2024).

In the Republic of Kazakhstan, more than 3,000 events were carried out in 2021 aimed at fostering a culture of anti-corruption and promoting integrity. In 2022, the number of events in this direction exceeded 11,000. However, despite a 3.5-fold increase in efforts to prevent corruption and promote integrity among public servants in 2022, the number of corruption crimes during that time rose by 10% (167 crimes) (National Anti-Corruption Report 2022, 2023).

Thus, promotional, educational, and preventive activities do not directly influence the advancement of the ideology of integrity among public servants and do not guarantee a reduction in instances of corruption crimes.

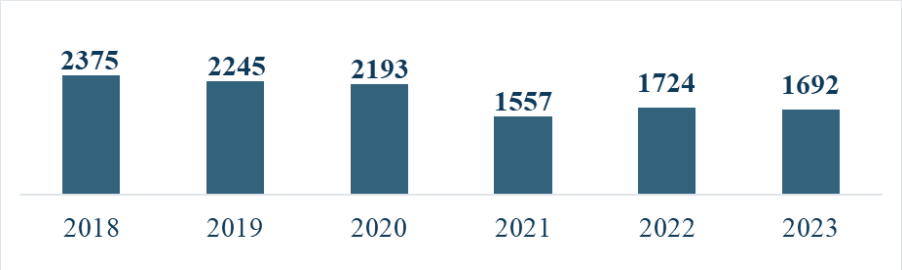

Figure 1 – Dynamics of Corruption Crimes in the Republic of Kazakhstan
Note – compiled by the authors based on (National Anti-Corruption Report 2023, 2024)

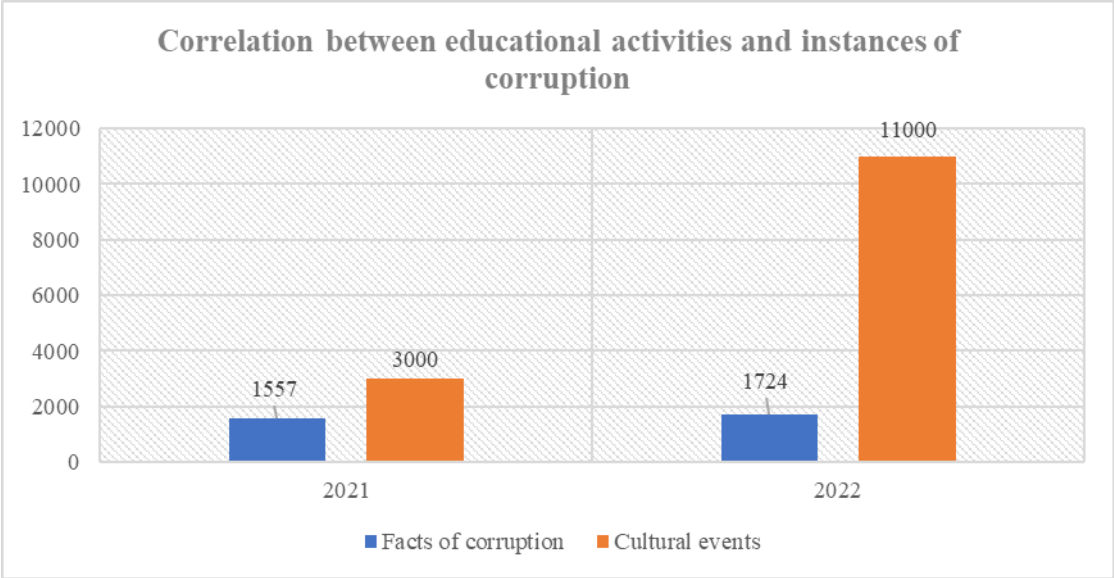

Figure 2 – Correlation between educational activities and instances of corruption
Note – compiled by the authors based on (National Anti-Corruption Report 2023, 2024)

Representatives of society and experts sometimes believe that public servants can only achieve integrity through the establishment of strict discipline, while others suggest that the only way to eradicate corruption is to impose long-term imprisonment on corrupt individuals or, in some cases, apply the death penalty.

We can examine countries that have opted for stringent measures, including the use of the death penalty as a means of deterrence, in promoting integrity. One such country is the neighboring People's Republic of China, located to the east of our republic. Article 383 of the Criminal Code of the PRC stipulates that "depending on the amount of the bribe and the circumstances, the punishment may range from imprisonment for up to 10 years without the possibility of early release, to, in cases of aggravating circumstances, the death penalty along with confiscation of property" (Criminal Code of the People's Republic of China, 2016).

Since the 2016 revision of the Criminal Code of the People's Republic of China, the sanctions of the aforementioned article have remained unchanged to the present day.

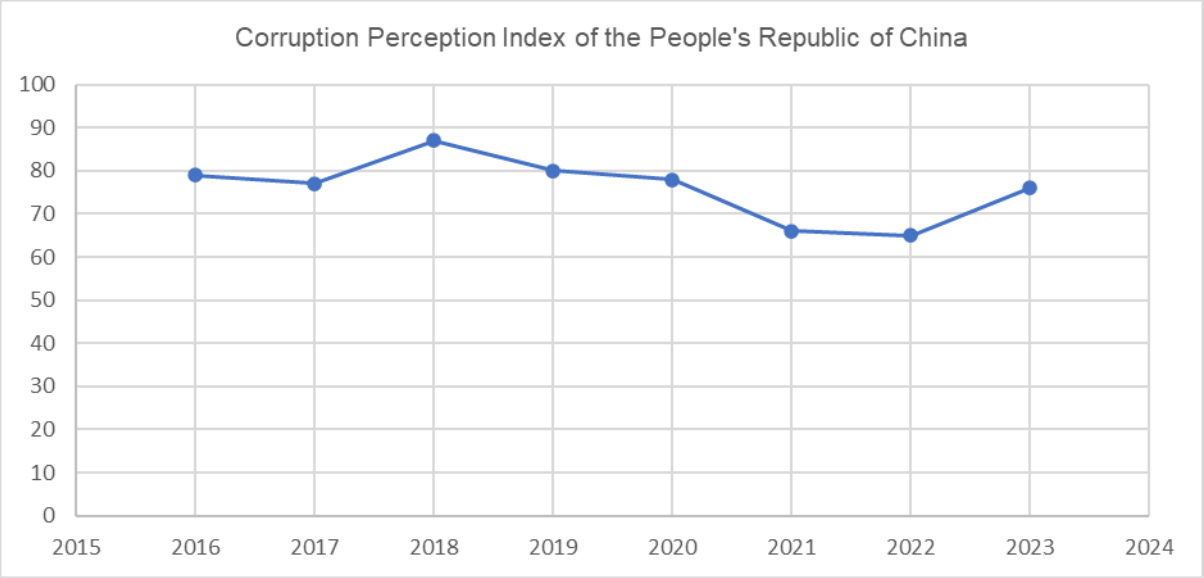

Figure 3 – Corruption perception index of the People's Republic of China according to Transparency International's research
Note – compiled by the authors based on (Transparency International, 2024)

China is among the countries with a high level of corruption, and it can be observed that strict penalties have not sufficiently advanced the ideology of integrity in public service.

The Republic of Cuba, which applies the death penalty for corruption offenses, ranks 76th in the Transparency International index, placing it among the countries with a high level of corruption.

Next, an analysis will be conducted on the practices of the Kingdom of Denmark in promoting integrity, which has held the first position in the Transparency International ranking for the past two years (Transparency International , 2024).

According to Denmark's Criminal Code, the harshest penalties for corruption crimes are six years of imprisonment for public servants and four years for members of the public (EU Anti-Corruption Report, 2014).

A study from the University of Copenhagen indicates that the low level of corruption in the Kingdom of Denmark is attributed to public servants who strictly adhere to ethical norms and prioritize the interests of society over their personal interests (Ryabova, 2019).

In Denmark, the income and expenditures of public servants can be monitored not only by government agencies but also by members of society, in accordance with the principle of transparency. This fiscal openness strengthens public accountability and helps prevent the illicit enrichment of officials. If discrepancies arise between a public servant's income and declared expenditures, the individual is required to provide a legitimate explanation for any excess income. Such measures contribute to the efficient use of public funds, reduce the risk of embezzlement and budgetary leakage, and foster a climate of economic integrity within the public sector, ultimately supporting the country's long-term economic sustainability and trust in state institutions.

The renowned humanist scholar Cesare Beccaria writes, "The effectiveness of a punishment is not determined by its severity, but by the inability to escape it" (Beccaria, 2004).

Thus, in Denmark, every crime elicits public outrage, is clearly visible to the public, and there is a complete awareness that public servants cannot escape punishment.

Moreover, considering that public servants in Denmark are paid at a very high level, the model demonstrates that the ideology of integrity can be promoted in an environment where the lifestyle of public servants is monitored not only by government agencies but also by society (Lipinskyi, 2019).

The international organization Transparency International, which evaluates the global index of corruption levels, does not give a positive assessment of the effective efforts being made in the Republic of Kazakhstan to combat and prevent corruption.

Table 1 – The ranking of Kazakhstan in the corruption index published by Transparency International

Year	Score	Ranking
2017	31	122
2018	31	124
2019	34	113
2020	38	94
2021	37	102
2022	36	101
2023	39	93
Note – compiled by the authors based on (Transparency International, 2025)		

For example, according to the ranking by the international organization Transparency International, the Republic of Kazakhstan was ranked 94th with 38 points in 2020, 102nd with 37 points in 2021, and stabilized at 101st place with 36 points in 2022 (Transparency International , 2024).

As noted, in the 2020 ranking by the organization, Kazakhstan achieved a level of success in combating this epidemic that had not been reached before. Let's discuss the changes that occurred in our country in 2019-2020 and how those changes affected the instances of corruption.

In 2020, by presidential decree, the "Factor-Point Scale for Public Servants" was implemented among public employees in our country. As a result, the salaries of several public servants increased by 1.5 to 2 times (Strategy "Kazakhstan 2050").

Furthermore, in our country, the annual inflation rate was 7.5% in 2020, 8.4% in 2021, and reached 18.8% in 2022 (National Bank of Kazakhstan, 2021)

Based on the above, it can be observed that the increase in public servants' salaries, along with the decrease in inflation, has contributed to a reduction in corruption offenses. For instance, in 2019, there were 2,245 cases of corruption, while in 2020, the number decreased to 2,191 (a 2.4% reduction).

Among these, the instances of public servants receiving bribes from members of the public decreased from 649 in 2019 to 568 in 2020. This indicates a relative decrease of 12.5% in bribery cases over the year (National Anti-Corruption Report 2021, 2022).

The research indicates that the advancement of the ideology of integrity in the Republic of Kazakhstan requires more than just a comprehensive approach to cultural, educational, and awareness-raising activities. There is an increasing need to implement economically grounded motivational mechanisms to foster a sustainable culture of integrity within public service. These mechanisms include ensuring financial independence through competitive and transparent remuneration systems, which reduce incentives for corrupt behavior. Moreover, strict adherence to the principles of meritocracy not only enhances fairness in public sector employment but also contributes to economic efficiency by optimizing human capital allocation. Strengthening these economic incentives is essential for building a professional and ethically resilient civil service that supports long-term institutional performance and fiscal responsibility.

It is well-known that financial motivation is the most effective form of motivation; this can be illustrated by Maslow's hierarchy of needs. For a public servant struggling to meet their basic physiological needs (such as rent and living expenses), it is extremely challenging to contemplate the future of their country or engage in thoughts of integrity and spiritual renewal.

An American psychologist states that a person who is unable to adequately meet their own or their family's physiological needs does not prioritize their safety needs (Samarina, 2022).

In other words, a civil servant who is unable to pay rent on time, provide bread and milk for their children, or is nearing the deadline for loan repayments will likely disregard discussions about honesty and integrity, as well as warnings about the harshness of the law and potential imprisonment. To fulfill their basic needs, they may prioritize immediate survival over their safety and principles, which increases the likelihood of engaging in unlawful behavior.

As evidence, a 2022 study conducted by British researchers Paul G. Bain and Renata Bondjorno found that 86% of respondents across 33 countries identified salary increases as the most significant motivation for employees to engage fully in their work. Conversely, only 14% of employees indicated that career advancement and status, rather than salary, served as their primary motivation (Kukova, 2022).

According to the author's thesis, an environment where salaries are at a sufficient level, the principles of meritocracy are strictly adhered to, and each civil servant is under public scrutiny can effectively promote the ideology of integrity. In such an environment, the number of individuals wishing to join increases, recruitment processes are strengthened, and

employees whose abilities and qualifications align are attracted to public service.

As evidence, when the factor-based scoring system was implemented in 2020, and salaries for employees increased, the number of candidates for each vacant position in the civil service rose by 2.6 times (Стратегия «Казахстан 2050»).

Currently, the National Bureau of Statistics reports that 25% of employees earn up to 105,000 tenge, while 36.9% earn between 105,000 and 210,000 tenge (Bureau Of National Statistics, 2024).

Thus, 62% of civil servants live on salaries below 210,000 tenge. It is known that these employees work in lower-ranking positions within the civil service. Allowing these groups to engage in additional work legally outside their official hours provides employees with the opportunity to earn extra income to support themselves and their families. This practice is implemented in England and Finland, where it is permitted with the approval of management, as long as it does not create conflicts of interest.

According to Doctor of Economic Sciences, Professor V.B. Zotov, increasing motivation among civil servants is closely linked to adequate and competitive salaries as well as a positive psychological climate in the workplace. From an economic perspective, the scholar emphasizes that financial incentives play a crucial role in enhancing labor productivity, reducing turnover, and attracting qualified professionals to the public sector. Furthermore, he argues that a favorable workplace environment – shaped by transparent decision-making, job security, and low levels of administrative pressure – significantly contributes to the efficiency and stability of public institutions. These factors collectively create conditions for a more economically sustainable and accountable public administration (Milkina, 2022).

Conclusion

This research examined the concept of integrity in the civil service, with a focus on its economic relevance and its role in enhancing the efficiency of public administration. Based on the analysis, the following conclusions can be drawn in accordance with the objectives outlined in the abstract:

1. On the significance of integrity and its economic dimensions in public administration:

Integrity serves not only as a moral foundation of civil service but also as a key driver of economic efficiency, institutional trust, and long-term governance performance. Promoting ethical behavior among civil servants contributes to the optimal use of public resources and the minimization of corruption-related economic losses.

2. On the theoretical and institutional mechanisms for fostering integrity in Kazakhstan:

The research confirms the necessity of embedding integrity into the public administration system through clear institutional mechanisms. These include performance-based remuneration, transparent decision-making, and economic incentives, all of which enhance the legitimacy and sustainability of anti-corruption efforts.

3. On the role of economic incentives, particularly the factor-point evaluation system:

Implementing a performance-based remuneration system, such as one based on a factor-point model, is identified as an effective economic tool for encouraging ethical conduct and improving labor productivity within the civil service. It also helps attract and retain competent professionals, thereby improving the overall quality of governance.

4. On international experience (Denmark and China):

The comparative analysis illustrates that Denmark's emphasis on competitive salaries, meritocracy, and civic participation provides a successful model for aligning ethical standards with economic rationality. In contrast, China's focus on legal enforcement highlights the limitations of punitive approaches in the absence of institutional and economic reform. Lessons from both countries underscore the importance of a balanced, economically informed integrity strategy.

5. On transparency, ethical standards, and digitalization:

Strengthening transparency and accountability – particularly through digital governance tools and e-government mechanisms – is essential for reducing corruption risks. These innovations not only promote institutional openness but also result in measurable economic benefits, such as improved budget execution and reduced administrative costs.

6. On the need to shift from traditional to incentive-based approaches:

While traditional anti-corruption measures (criminal prosecution, audits, training) remain important, the study emphasizes the growing relevance of incentive-based mechanisms. These include fair compensation, career advancement opportunities, and a supportive work environment, all of which are essential for fostering a resilient culture of integrity.

In conclusion, advancing integrity in Kazakhstan's civil service demands a comprehensive, economically grounded approach. It is not the sole

responsibility of enforcement bodies, but a shared duty of institutions, businesses, and society. By combining ethical standards with smart economic policy, Kazakhstan can build a public administration system that is not only morally sound but also cost-effective, accountable, and future-oriented.

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АВТОРЛАРҒА АРНАЛҒАН АҚПАРАТ

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ҚазҰУ Хабаршысы. Экономика сериясында материалдарды жариялау Open Journal System, онлайн жіберу және рецензиялау жүйесі арқылы жүзеге асырылады.

Корреспонденция авторы журналға жариялау үшін ілеспе хат ұсынуға міндетті.

Авторларға қойылатын талаптар: Редакциялық коллегия журналдың ғылыми бағыттары бойынша бұрын жарияланбаған мақалаларды қабылдайды. Мақала журналдың функционал сайтына жүктеу арқылы ғана (Open Journal System) электронды форматта (doc, .docx, .rtf форматында) қабылданады. Шрифт кеглі – 12 (аңдатпа, түйін сөздер, әдебиеттер тізімі – 10, кесте мәтіні – 9-11), шрифт – Times New Roman, мәтін беттің ені бойынша тегістеу арқылы теріледі, аралығы – бір, абзац бойынша шегініс – 0,8 см, шеттері: үстіңгі және астыңғы – 2 см, сол және оң жақ – 2 см. Сурет, кесте, графика, диаграмма және т.б. мәтін ішінде нөмір және атаумен белгіленеді (мысалы, 1-сурет – Сурет атауы) және және ескерту түрінде дереккөз көрсетіледі (мысалы, Ескерту – ... дереккөзі негізінде автормен құрастырылған). Суреттердің, таблица, графика мен диаграммалардың саны мақала көлемінің 20% -нан (кейбір жағдайда 30%) артық болмауы керек. Мақала көлемі (атауы, авторлар бойынша ақпарат, аңдатпа, түйін сөздер, әдебиеттер тізімін қоспағанда) әлеуметтік және гуманитарлық бағытта 3 000 сөзден кем емес, 7 000 сөзден артық емес болуы шарт.

Мақаланы жариялау үшін ақы төлеу тәртібі мен құнын «Қазақ университеті» баспасы белгілейді және оны рецензенттер мен ғылыми редактор мақұлдағаннан кейін автор жасайды.

Мақала құрылымы: Бірінші бет: Бірінші жол – ҒТАХР нөмірі, мәтін беттің сол жақ шетімен тегістеледі, қаралау шрифт. Мақала автор(лар)ы – аты-жөнінің бірінші әріптері және тегі, жұмыс істейтін орны (аффилиация), қала, мемлекет, e-mail, ORCID ID – орыс, қазақ және ағылшын тілдерінде жазылады. Авторлар туралы ақпарат қалыпты шрифтті кіші әріптермен жазылып, беттің ортасында тегістеледі.

Мақала атауы (Тақырып) мақаланың мәні мен мазмұнын көрсетіп, оқырманның назарын аудару керек. Тақырып қысқа әрі ақпараттық, жаргондар мен аббревиатурасыз жазылуы тиіс. Тақырыптың орташа ұзындығы 5-7 сөз (кей жағдайда 10-12 сөз). Мақаланың тақырыбы орыс, қазақ және ағылшын тілдерінде берілуі керек. Тақырып қаралау шрифтті кіші әріптермен, беттің ортасымен тегістеледі. Аңдатпа көлемі – 150 сөзден кем емес, 300 сөзден артық емес орыс, қазақ, ағылшын тілдерінде жазылады.

Аңдатпа құрылымында келесі ақпарат міндетті түрде болуы керек: Зерттеу тақырыбы бойынша кіріспе сөз; Ғылыми зерттеудің мақсаты, негізгі бағыттары мен идеялары; Жұмыстың ғылыми және практикалық маңыздылығы бойынша қысқа ақпарат; Зерттеу әдістемесі бойынша қысқа ақпарат; Ғылыми зерттеудің негізгі нәтижелері, талдау және түжырымдама; Жүргізілген зерттеу жұмысының маңыздылығы (аталған жұмыстың ғылымның сәйкес саласына енгізген үлесі); Жұмыс қорытындысының практикалық маңыздылығы.

Түйін сөздер/сөз тіркестері – орыс, қазақ, ағылшын тілдерінде 3-5 сөз аралығында.

Кіріспе келесіде берілген негізгі элементтерден тұрады: Таңдалған тақырыптың негіздемесі; тақырып өзектілігі мен зерттеу проблемалары. Таңдалған тақырыптың негіздемесінде алдыңғы зерттеушілердің тәжірибелері негізінде проблемалық жағдайдың (зерттеу жұмыстарының жоқтығы, жаңа зерттеу нысанының пайда болғаны және т.б.). бар екендігі айтылады. Тақырыптың өзектілігі аталған зерттеу нысанының қойылған сұрақтарға толық жауаптардың болмаған жағдайда, тақырыптың теориялық және практикалық маңыздылығы арқылы дәлелденіп жалпыға ортақ мүдде арқылы анықталады. Жұмыстың нысанын, пәнін, мақсаттарын, міндеттерін, тәсілдерін, әдістер, гипотезасын анықтау. Зерттеудің мақсаты тезисті дәлелдеумен, яғни зерттеу тақырыбын автор таңдаған аспектімен көрсетумен байланысты.

Әдебиеттерге шолу бөлімінде – зерттеу тақырыбы бойынша ағылшын тілінде шетелдік авторлардың іргелі және жаңа еңбектер (кемінде 15 жұмыс), оларды ғылыми үлесі түрғысынан талдау, сондай-ақ сіздің мақалаңызда толықтырылған зерттеу кемшіліктері беріледі.

Әдістеме – материалдар мен жұмыс барысының сипаттамасынан, сондай-ақ қолданылатын әдістердің толық сипаттамасынан тұруы керек.

Нәтижелер мен Талқылау бөлімінде сіздің зерттеу нәтижелеріңізді талдауы және талқылауы беріледі. Зерттеу барысында алынған нәтижелер туралы қорытынды беру арқылы негізгі мәні айқындалады. Бұл мақаланың маңызды бөлімдерінің бірі болып саналады. Онда жұмысыңыздың нәтижелерінің талдауы және алдыңғы жұмыстармен, талдаулармен және түжырымдамаларымен салыстыру арқылы сәйкес нәтижелерді талқылау беріледі.

Қорытынды – жұмыстың осы кезеңдегі нәтижелерін жалпылау және қорытындылау; автор алға қойған түжырымның растығын және алынған нәтижелерді ескере отырып, ғылыми білімнің өзгеруі туралы автордың қорытындысын растау. Қорытынды абстрактілі болмауы керек, оларды ұсыныстарды немесе одан әрі жасалатын жұмысты сипаттай отырып белгілі бір ғылыми саладағы зерттеу нәтижелерін жалпылау үшін қолдану керек.

Пайдаланылған әдебиеттер тізімі немесе библиографиялық тізім жаратылыстану және техникалық бағыттарға кем дегенде 15 атаулардан тұрады, ал ағылшын тіліндегі жалпы атаулар саны 50%-дан кем болмауы керек. Егер сілтемелер тізімінде кириллицада берілген еңбектер болса, сілтемелер тізімін екі нұсқада ұсыну қажет: біріншісі – түпнұсқада, екіншісі – романизацияланған алфавитте (транслитерация – translit-online.ru).

Әлеуметтік және гуманитарлы бағыттағы мәтіндерде дәйексөз келтірілген сілтемелер жұмыстың бірінші авторы, шыққан жылы: бет нөмір(лер)і жақша ішінде көрсетіліп беріледі. Мысалы, (Залесский, 1991: 25). Әдебиеттер тізімінде бір автордың бір жылда жарық көрген бірнеше жұмысы келтірілген жағдайда, шыққан жылдың түсына «а», «б» және т.б. әріптерді қосып жазу керек. Мысалы, (Садуова, 2001а: 15), (Садуова, 2001б, 22). Мақала жариялау құны – 2000 теңге / бет

ИНФОРМАЦИЯ ДЛЯ АВТОРОВ

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Порядок оплаты и стоимость за публикацию статьи устанавливается издательским домом «Қазақ университеті» и производится автором после одобрения рецензентами и научным редактором.

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Название статьи (Заголовок) должно отражать суть и содержание статьи и привлекать внимание читателя. Название должно быть кратким, информативным и не содержать жаргонизмов или аббревиатур. Оптимальная длина заголовка – 5-7 слов (в некоторых случаях 10-12 слов). Название статьи должно быть представлено на русском, казахском и английском языках. Название статьи представляется полужирным шрифтом строчными буквами, выравнивание – по центру;

Аннотация объемом не менее 150 и не более 300 слов на русском, казахском и английском языках. Структура аннотации включает в себя следующие обязательные пункты: Вступительное слово о теме исследования; Цель, основные направления и идеи научного исследования; Краткое описание научной и практической значимости работы; Краткое описание методологии исследования; Основные результаты и анализ, выводы исследовательской работы.

Ключевые слова/словосочетания – количеством 3-5 на русском, казахском и английском языках;

Введение состоит из следующих основных элементов: Обоснование выбора темы; актуальность темы или проблемы. В обосновании выбора темы на основе описания опыта предшественников сообщается о наличии проблемной ситуации (отсутствие каких-либо исследований, появление нового объекта и т.д.).

Актуальность темы определяется общим интересом к изученности данного объекта, но отсутствием исчерпывающих ответов на имеющиеся вопросы, она доказывается теоретической или практической значимостью темы.

Определение объекта, предмета, целей, задач, методов, подходов, гипотезы и значения вашей работы. Цель исследования связана с доказательством тезиса, то есть представлением предмета исследования в избранном автором аспекте.

В секции обзор литературы – должны быть охвачены фундаментальные и новые труды по исследуемой тематике зарубежных авторов на английском языке, анализ данных трудов с точки зрения их научного вклада, а также пробелы в исследовании, которые Вы дополняете в своей статье.

Методология – должны состоять из описания материалов и хода работы, а также полного описания использованных методов.

В разделе Результаты и Обсуждение – приводится анализ и обсуждение полученных вами результатов исследования. Приводятся выводы по полученным в ходе исследования результатам, раскрывается основная суть. И это один из самых важных разделов статьи. В нем необходимо провести анализ результатов своей работы и обсуждение соответствующих результатов в сравнении с предыдущими работами, анализами и выводами.

Заключение – обобщение и подведение итогов работы на данном этапе; подтверждение истинности выдвигаемого утверждения, высказанного автором, и заключение автора об изменении научного знания с учетом полученных результатов. Выводы не должны быть абстрактными, они должны быть использованы для обобщения результатов исследования в той или иной научной области, с описанием предложений или возможностей дальнейшей работы.

Список используемой литературы, или Библиографический список состоит из не менее 15 наименований, и из общего числа наименований на английском языке должно быть не менее 50%. В случае наличия в списке литературы работ, представленных на кириллице, необходимо представить список литературы в двух вариантах: первый – в оригинале, второй – романизированным алфавитом (транслитерация – translit-online.ru).

Ссылки на цитируемые работы в тексте даются в скобках, с указанием первого автора работы, год издания: номер страниц(-ы). Например, (Залесский, 1991: 25). Стоимость публикации – 2000 тенге/страница

INFORMATION FOR AUTHORS

The authors can be:

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- persons engaged in scientific and pedagogical activities.

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Structure of the article: First page: First line – IRSTI number (international rubricator of scientific and technical information), alignment – left, font – bold. Author(s) of the article – Initials and surname, place of work (affiliation), city, country, e-mail, ORCID ID. Information about authors is represented in ordinary type in lowercase letters, alignment in the center. The title of the article should reflect the essence and content of the article and attract the reader's attention. The title should be short, informative and not contain jargons or abbreviations. The optimal length of the title is 5-7 words (in some cases 10-12 words). The title of the article is shown in bold in lowercase letters, alignment – in the center. Abstract – at least 150-300 words.

The structure of the annotation includes the following obligatory items: Opening remarks about the research topic, purpose, main directions and ideas of scientific research, brief description of the scientific and practical significance of the work, brief description of the research methodology, main results and analysis, conclusions of research work, the value of the research carried out (contribution of this work to the relevant field of knowledge).

Keywords – 3-5 words.

Introduction consists of the following main elements: Justification of the choice of topic; relevance of the topic or problem. In substantiation of the choice of topic based on the description of the experience of predecessors, the presence of a problem situation (the absence of any research, the emergence of a new object, etc.) is reported.

The relevance of the topic is determined by the general interest in the knowledge of this object, but the lack of comprehensive answers to the questions, it is proved by the theoretical or practical significance of the topic.

In the literature review section, fundamental and new works on the subject matter of foreign authors in English should be covered (at least 15 works), analysis of the given works in terms of their scientific contribution, as well as research gaps that you supplement in your article.

Methodology should consist of a description of the materials and the progress of the work, as well as a complete description of the methods used.

In the Results and Discussion section an analysis and discussion of the research results you received is provided. The conclusions on the results obtained during the study are given, the main essence is revealed. And this is one of the most important sections of the article. It is necessary to analyze the results of their work and discuss the relevant results in comparison with previous works, analyzes and conclusions.

Conclusion – synthesis and summarizing the work at this stage; confirmation of the truth of the statement put forward by the author, and the author's conclusion on the change of scientific knowledge, taking into account the results obtained. Conclusions should not be abstract, they should be used to summarize the results of research in a particular scientific field, with a description of the proposals or opportunities for further work.

References consists of at least 15 titles, and from the total number of titles in English must be at least 50%. style of the list of references – American Psychological Association (http://www.apastyle.org/). The list of references is presented in alphabetical order, and ONLY those works that are cited in the text. References to cited works in the text are given in brackets, indicating the first author of the work, year of publication: the number of pages. For example, (Zalessky, 1991: 25). Publication cost – 2000 tenge/page

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