Towards a Digitally Sovereign Arctic: The Transformation Blueprint for Khanty-Mansiysk Autonomous Okrug – Yugra

Prepared for: Government of Khanty-Mansiysk Autonomous Okrug – Yugra (KhMAO).

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Date of Submission: May 2025

1. Executive Summary

This report details the findings and recommendations of the International Expert Group on Regional IT Agenda, established under the auspices of the Northern Forum, concerning the digital transformation strategy for the Khanty-Mansiysk Autonomous Okrug – Yugra (KhMAO). Mandated following the 15th General Assembly of the Northern Forum in July 2023, the expert group aims to foster interregional cooperation and advance digital infrastructure and applications across Northern and Arctic territories.

The assessment reveals KhMAO possesses significant strengths, particularly in household broadband penetration and the adoption of specific enterprise technologies like Enterprise Resource Planning (ERP) and Geographic Information Systems (GIS), largely driven by the dominant oil and gas sector. However, challenges persist, including a nascent Artificial Intelligence (AI) ecosystem reliant on federal initiatives, data silos hindering broader innovation, a shortage of specialized local AI talent, and lagging adoption of cloud computing and the Internet of Things (IoT) compared to the region's potential and infrastructure capabilities, especially outside major urban centers.

Key recommendations focus on a multi-faceted strategy encompassing policy refinement, infrastructure enhancement, innovation fostering, targeted sectoral applications, workforce development, and robust security measures. Specific proposals include establishing dedicated AI testing facilities and sandboxes, launching a "Yugra AI Pioneers" initiative to cultivate local talent and startups, strengthening partnerships with national tech leaders, enhancing digital skills through educational reforms, improving cybersecurity resilience, and leveraging digital technologies in key sectors such as energy, healthcare, transportation, and environmental monitoring. The report emphasizes the need for a collaborative approach involving government, industry, academia, and the community to realize KhMAO's potential as a digitally sovereign and competitive region within the Russian Federation and the broader Arctic context.

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2. Introduction

2.1 Background

The imperative for enhanced digital transformation within Northern and Arctic territories gained significant momentum following the 15th General Assembly of the Northern Forum, which convened on July 7–8, 2023. Recognizing the strategic significance of leveraging information technology for sustainable development and interregional cooperation, Natalia Komarova, the Chair of the Northern Forum and Governor of Khanty-Mansiysk Autonomous Okrug - Yugra, issued formal instructions to prioritize these efforts. A key component of this directive was the establishment of a specialized International Expert Group dedicated to shaping the Regional IT Agenda.

Supported by the Northern Forum Secretariat and through collaborative efforts with regional governments, ambassadors, and academics, the groundwork for this expert group was established by early 2024. The group held its inaugural formal meeting during the XV International IT Forum, which included participation from BRICS and SCO nations, in Khanty-Mansiysk on June 19, 2024. This meeting brought together a distinguished assembly of experts and institutional leaders from Russia, China, India, and Iceland, marking a significant step towards structured international collaboration in the digital domain within the Northern Forum framework.

2.2 Purpose and Scope

This report serves as a comprehensive submission detailing the assessment of the digital landscape within the Khanty-Mansiysk Autonomous Okrug – Yugra (KhMAO) and outlining strategic recommendations for its digital transformation. Prepared by the International Expert Group on Regional IT Agenda, the primary objective is to provide actionable insights and a structured plan suitable for consideration by relevant government offices. The scope encompasses an analysis of KhMAO's current digital infrastructure, enterprise technology adoption, digital competence levels, and a comparative perspective against other relevant Russian regions and national averages. Furthermore, it proposes a roadmap for future development, focusing on policy, infrastructure, innovation, workforce skills, and security, aligning with both regional priorities and national digital strategies.

2.3 Strategic Context

The development and implementation of a robust regional IT agenda are situated within a broader strategic context where digital sovereignty is increasingly paramount. Control over national and regional data, coupled with expertise in advanced technologies like artificial intelligence (AI), is becoming fundamental to maintaining economic competitiveness and autonomy. As global power dynamics shift towards information and algorithmic influence, a region's capacity to manage its digital territory, preserve its historical and cultural identity digitally, and direct its own development trajectory is intrinsically linked to its sovereign control. In this environment, initiatives that promote open access to data, foster connections with global knowledge networks, and support AI research are not merely technological upgrades but essential components of sustainable development and strategic positioning. The International Expert Group's work, therefore, aims to bolster KhMAO's digital capabilities as a cornerstone of its future prosperity and resilience.

2.4 Methodology

The findings and recommendations presented in this report are based on a comprehensive assessment methodology. This involved the analysis of official statistics, primarily drawn from publications by the National Research University Higher School of Economics (HSE) detailing digital economy indicators for the Russian Federation, alongside data potentially available from regional sources such as the Department of Information Technologies and Digital Development of KhMAO (DepIT Admhmao) and Rosstat. Qualitative insights were derived from the expertise and contributions of the International Expert Group members. A comparative analysis approach was employed, benchmarking KhMAO's digital indicators against other Northern and Arctic regions within Russia (e.g., Sakha Republic, Yamal-Nenets AO, Chukotka AO), major metropolitan centers (Moscow, St. Petersburg), and national averages. This multi-faceted approach allows for the identification of regional strengths, weaknesses, opportunities, and threats (SWOT) in the digital domain, informing the development of targeted and evidence-based recommendations.

3. The Northern Forum International Expert Group on Regional IT Agenda

3.1 Establishment and Mandate

The International Expert Group on Regional IT Agenda was formally initiated following the 15th General Assembly of the Northern Forum held on July 7–8, 2023. Responding to the strategic need for digital advancement in Northern and Arctic regions, Natalia Komarova, Governor of Khanty-Mansiysk Autonomous Okrug - Yugra and Chair of the Northern Forum, issued instructions for the development of interregional cooperation, explicitly mandating the creation of this specialized IT-focused group. With coordination from the Northern Forum Secretariat and regional governments, the group's foundation was laid by early 2024. Its formal establishment was marked by the inaugural meeting held on June 19, 2024, during the XV International IT Forum with BRICS and SCO Participation in Khanty-Mansiysk, signifying its integration into the Northern Forum's operational structure and planning processes.

3.2 Structure and Governance

The **Expert Group on Digital Transformation**, operating under the **Northern Forum framework**, serves as a strategic advisory and coordination unit focused on promoting innovation and practical digital solutions across Arctic and Northern regions. Its purpose is to bridge **scientific research**, **regional development needs**, and **technological advancement** for sustainable impact.

Formally recommended by the **Governor of KhMAO** and endorsed during its inaugural session, the group is composed of a diverse membership of academic, policy, and industry leaders representing both **Northern Forum member regions** and global collaborators. Notable participants include **Indraraj Dodiya** (Dodiya Enterprises LLC), **Sanjeev Singh** (Delhi University), **Li Yingqiu** (Dalian Neusoft University of Information), **Igor Marchuk** (Novosibirsk State University), **Halldor Johannsson** (Arctic Portal), and representatives from the **Russian Academy of Sciences** and various regional institutions.

Activities are coordinated by **Vladimir Vasilev**, Executive Director of the Northern Forum, with rotating regional chairs and thematic coordinators ensuring inclusive and interdisciplinary

collaboration. The group's roadmap was further promoted during the Northern Forum's **Regional Coordinators Committee** meeting in St. Petersburg (December 2024).

With implementation of *Постановление Губернатора №124 от 28.11.2024*, the **Department of IT and Digital Development** now plays a strengthened role in **information security policy**, **incident response coordination**, and **oversight across all governmental and municipal levels**. The Expert Group in this reference will keep supporting this mandate by contributing cross-border expertise on **cyber resilience** and **regional ICT readiness**.

Additionally, *Постановление Губернатора №136 от 11.12.2024* updated the remit of the **Commission for Digital Development under the Governor**. Now tasked with aligning regional digital development across **education, healthcare, energy, and public administration**, this Commission serves as a strategic point of integration. The Expert Group's findings and thematic inputs will feed into Commission deliberations, ensuring regional needs and international perspectives shape key decisions—particularly regarding **digital maturity** and **sectoral digitalization** goals.

3.3 Role and Activities

The International Expert Group on Regional IT Agenda fulfills several critical roles to advance the digital transformation objectives within the Northern Forum's scope, particularly focusing on KhMAO. It functions as a **Strategic Advisory Body**, providing expert counsel to regional authorities on digital transformation strategies, smart infrastructure development, and IT policy formulation, helping to define long-term digital goals aligned with regional needs and global standards. As a **Technology Watchdog and Evaluator**, the group monitors emerging digital trends (including AI, 5G, cloud computing, and cybersecurity) and assesses their suitability for local adaptation and infrastructure scaling within the region.

Furthermore, the group acts as a **Capacity Builder**, organizing training programs, workshops, and supporting educational institutions in developing curricula to enhance local IT skills and digital literacy. It serves as an **Innovation Accelerator** by facilitating pilot projects, establishing testbeds for new technologies (e.g., smart cities, e-governance, digital health), and encouraging public-private partnerships for smart infrastructure development. In its role as a **Policy Harmonizer**, the group works to align regional IT development with federal policies and international standards (such as EU digital strategies and UN Sustainable Development Goals) and develops interoperability guidelines for digital governance. Finally, as an **Investment Enabler**, it seeks to attract domestic and foreign investment into regional IT projects and connect local initiatives with international grant programs and development banks.

Key activities undertaken by the group to fulfill these roles include conducting **Digital Maturity Assessments** for cities and regions, developing **Roadmaps** for IT infrastructure with clear milestones and KPIs, hosting **Regional Think Tank Forums** with global experts, promoting **Open Data and AI Programs** for public benefit, designing **Smart City Initiatives**, defining **Cybersecurity Frameworks**, and fostering **Cultural-Tech Synergy** through initiatives like language technology promotion. The overarching aim is to guide a structured, sustainable, and inclusive digital transformation that empowers citizens and businesses, bridges digital divides, and enhances the region's digital sovereignty and competitiveness.

4. Digital Landscape Assessment: Khanty-Mansiysk Autonomous Okrug – Yugra

This section provides a comprehensive assessment of the digital landscape within the Khanty-Mansiysk Autonomous Okrug – Yugra (KhMAO), establishing a baseline understanding of its digital infrastructure, technology adoption, and competence levels. The analysis utilizes key performance indicators, compares KhMAO with other relevant Russian regions and national averages, and incorporates the most recent available data to provide an updated context.

4.1 Assessment Framework

To evaluate the digital development status of KhMAO and facilitate comparison with other regions, a set of key indicators reflecting various dimensions of the digital economy was employed. These indicators, primarily sourced from national statistical collections like the HSE Data Books, cover infrastructure availability, technology adoption by enterprises and individuals, and digital skills. The core indicators used in this assessment include:

- **Fixed Broadband Subscriptions:** Number of fixed broadband subscriptions per 100 inhabitants, indicating the penetration of high-speed internet infrastructure.
- **Mobile Broadband Subscriptions:** Number of mobile broadband subscriptions per 100 inhabitants, reflecting the reach and usage of mobile internet services.
- **Households with Broadband Access:** Percentage of households with access to broadband internet, signifying digital inclusion at the household level.
- **E-commerce Usage:** Share of individuals (aged 15–74) using the internet for purchasing goods or services, indicating digital consumer behavior.
- **Enterprises' Use of Cloud Computing Services:** Percentage of enterprises utilizing cloud computing, reflecting the adoption of modern, scalable IT solutions.
- **Enterprises' Use of Big Data Technologies:** Percentage of enterprises employing big data analytics, highlighting advanced technological capabilities.
- **Enterprises' Use of Digital Platforms, ERP, AI, IoT, and GIS:** Percentage of enterprises adopting specific advanced digital technologies, including Enterprise Resource Planning (ERP) systems, Artificial Intelligence (AI), the Internet of Things (IoT), and Geographic Information Systems (GIS).
- **Digital Competence:** An index or score reflecting the population's ability to effectively utilize digital tools and navigate the digital environment, often based on self-reported skills or usage patterns.

4.2 Comparative Analysis (Based on 2021 Data)

To contextualize KhMAO's digital standing, its performance across the key indicators (based primarily on 2021 data, as presented in the initial assessment) was compared with several other Russian regions and the national average. The selected regions include other Northern/Arctic territories, major economic centers, and regions with varying levels of digital development:

- Sakha Republic (Yakutia)
- Kamchatka Krai
- Krasnoyarsk Krai
- Magadan Oblast

- Nenets Autonomous Okrug
- Khabarovsk Krai
- Chukotka Autonomous Okrug
- Yamal-Nenets Autonomous Okrug
- Saint Petersburg
- Moscow

The following table summarizes the key digital economy indicators for these regions based on 2021 data:

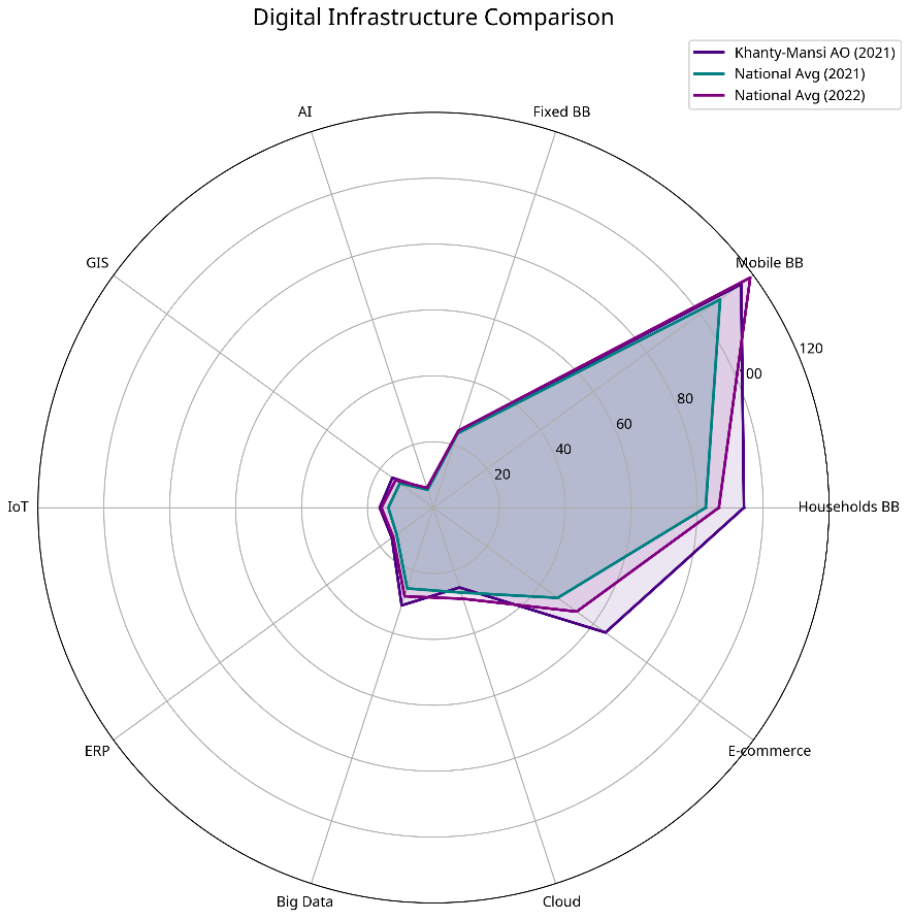
Table 1: Digital Economy Indicators for Selected Russian Regions (2021)

Region	Fixed BB (/100)	Mobile BB (/100)	Households BB (%)	E-commerce (%)	Cloud (%)	Big Data (%)	Digital Platforms (%)	ERP (%)	IoT (%)	GIS (%)	AI (%)	Digital Competence
Chukotka AO	11.0	104.4	92.0	43.6	19.1	34.4	13.2	5.2	13.4	10.6	4.9	57
Kamchatka Krai	16.3	112.1	88.0	56.0	20.7	25.4	10.6	6.5	12.5	12.1	3.6	55
Khanty-Mansi AO – Yugra	**24.4**	**115.4**	**94.2**	**64.5**	**25.5**	**31.2**	**16.0**	**15.6**	**16.3**	**15.4**	**5.9**	**64**
Khabarovsk Krai	26.7	107.4	80.8	39.2	22.6	27.5	13.0	12.4	12.4	12.8	4.1	59
Krasnoyarsk Krai	16.4	102.4	74.2	36.3	23.1	22.2	13.1	11.5	10.6	13.0	3.8	60
Magadan Oblast	20.1	110.9	93.1	47.4	23.8	30.0	14.1	9.1	16.4	14.2	4.8	58
Moscow	38.4	138.7	94.4	71.4	29.4	25.5	13.0	13.3	11.8	7.2	3.9	85
Nenets AO	21.1	-	81.5	51.2	18.7	17.7	9.0	8.4	9.5	11.1	2.4	54
Russia (National Avg.)	**23.7**	**107.5**	**82.6**	**46.6**	**27.1**	**25.8**	**14.7**	**13.8**	**13.7**	**12.6**	**5.7**	**58**
Sakha Republic (Yakutia)	18.6	96.7	85.6	41.0	26.0	27.7	13.9	7.8	14.6	13.2	3.3	56
St Petersburg	29.2	141.4	87.3	68.4	30.9	28.0	15.1	15.9	13.9	10.6	4.2	80
Yamal-Nenets AO	23.5	137.5	98.4	80.9	23.2	31.4	13.7	15.0	13.7	15.4	4.6	63

(Source: Adapted from original report data, based on HSE Digital Economy Indicators 2021)

Key Insights from 2021 Data:

- **Infrastructure:** KhMAO demonstrated strong fixed (24.4/100) and mobile (115.4/100) broadband subscription rates, exceeding the national average. Household broadband access (94.2%) was particularly high, comparable to Moscow (94.4%) and surpassed only by Yamal-Nenets AO (98.4%). This indicates a robust foundational connectivity infrastructure.



- **Usage:** E-commerce usage in KhMAO (64.5%) was significantly above the national average (46.6%), suggesting active digital consumer participation, though lower than Moscow (71.4%) and Yamal-Nenets AO (80.9%).
- **Enterprise Adoption:** KhMAO showed notable strength in adopting specific enterprise technologies, particularly ERP (15.6%), IoT (16.3%), and GIS (15.4%), all exceeding national averages (13.8%, 13.7%, 12.6% respectively) and surpassing even Moscow and St. Petersburg in IoT and GIS adoption. Cloud usage (25.5%) was slightly below the national average (27.1%), while Big Data usage (31.2%) and Digital Platform adoption (16.0%) were above average.
- **AI Adoption:** AI adoption by enterprises (5.9%) was marginally above the national average (5.7%).

- **Digital Competence:** KhMAO's digital competence score (64) was above the national average (58) but significantly lagged behind the leading centers of Moscow (85) and St. Petersburg (80).
- **Lagging Regions:** Chukotka AO and Nenets AO generally showed lower levels of technology adoption and digital competence, despite moderate infrastructure indicators in some cases, highlighting the challenges faced by sparsely populated, remote Arctic regions.

4.3 In-depth Analysis of KhMAO (2021 Baseline)

Building on the comparative data, the 2021 baseline assessment revealed specific characteristics of KhMAO's digital environment:

- **Infrastructure Status:** While major cities likely benefit from FTTB and 4G/LTE providing speeds adequate for many applications (100+ Mbps), remote areas and industrial sites often rely on slower connections (10-30 Mbps) or VSAT satellite, which presents latency challenges (600ms+) unsuitable for real-time IoT or cloud-dependent applications. The reliance on satellite, even as backup, and the speed disparities between urban and remote areas represent key infrastructure limitations despite high overall access figures.
- **Enterprise Technology Adoption:** The high adoption rates of ERP and GIS are strongly linked to the needs of the dominant oil and gas sector for logistics coordination, resource mapping, pipeline monitoring, and regulatory compliance in challenging Arctic conditions. The relatively lower adoption of cloud and IoT can be attributed to factors like reliance on older Industrial Control Systems (ICS), concerns about cybersecurity risks during upgrades, connectivity limitations in remote operational areas, and regulatory constraints such as data localization laws (e.g., Federal Law № 242-FZ) encouraging on-premise data centers for critical infrastructure.
- **Digital Competence Profile:** Analysis indicated a mixed profile: a relatively low percentage of the population with 'Low' competence compared to the national average, but also a smaller proportion achieving 'Above basic' skills compared to leading regions. A significant portion (17% in 2021) had not used the internet recently, suggesting access or adoption barriers persist despite high household connectivity. This points to strong foundational literacy but a need for advanced skills development and efforts to engage the offline population.
- **Identified Gaps:** Key weaknesses identified included a limited local AI ecosystem (few research hubs, weak startup scene, reliance on federal programs, brain drain to major cities), data silos primarily within large energy companies restricting broader use, underdeveloped local computing infrastructure (reliance on Moscow/Siberian data centers), absence of local AI cloud platforms, and a shortage of specialized AI workforce coupled with limited dedicated AI curricula in local universities.

4.4 Updated Context (2022-2023 Data and Trends)

Incorporating data available up to early 2024 (primarily reflecting 2022 figures from HSE publications and indicative regional reports from 2023) provides an updated perspective:

- **National Trends:** National household internet and broadband access continued to rise in 2022 (86.6% and 85.5% respectively). Daily internet usage also increased nationally (84.9%). Enterprise adoption of cloud and big data remained stable nationally at 27.1% and

25.8% respectively in 2022. National digital competence profiles showed improvement, particularly in reducing the share of the population with 'Low' or 'Below basic' skills.

- **Regional Updates:** Reports from 2023 suggest KhMAO continued efforts to enhance digital literacy through targeted programs reaching numerous settlements. The region also reportedly achieved high rankings (digital literacy score of 6.84) during Digital Dictation 2023" event which is one of the factor to analyse the digital transformation assessments, indicating recognized progress at the federal level. E-government service usage likely increased, aligning with national trends (66% nationally in 2022).

Reassessment of KhMAO's Position:

Based on the 2021 baseline and subsequent national trends and regional reports, KhMAO appears to maintain its key strengths while facing persistent challenges:

- **Persistent Strengths:** High household broadband penetration remains a core asset. Strong adoption of ERP, IoT, and GIS, driven by the energy sector, likely continues to be a defining feature.
- **Persistent Challenges:** The identified gaps in the AI ecosystem (research, startups, talent), data infrastructure limitations beyond the energy sector, the digital skills gap (particularly advanced skills), and potentially slower cloud adoption compared to national potential likely remain key areas requiring focused intervention. Addressing connectivity and speed limitations in rural and industrial zones is also crucial for enabling wider adoption of technologies like IoT and cloud services.

The overall assessment indicates that while KhMAO has a strong digital foundation, particularly in basic connectivity and specific industrial applications, realizing its full potential for broader digital transformation requires strategic efforts to cultivate a more diverse innovation ecosystem, enhance advanced digital skills, modernize data infrastructure, and overcome connectivity barriers in remote areas.

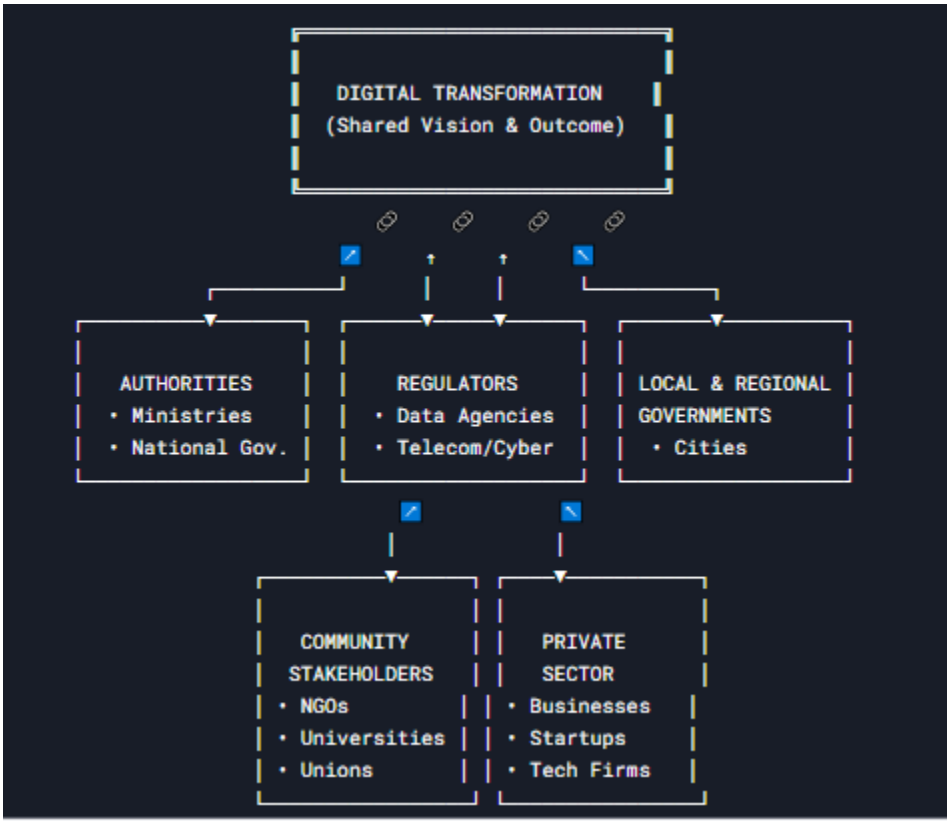
5. Recommendations for Digital Transformation in KhMAO

Building upon the assessment of Khanty-Mansiysk Autonomous Okrug – Yugra's (KhMAO) digital landscape, this section outlines a comprehensive set of recommendations designed to accelerate the region's digital transformation. These recommendations address key areas including policy, infrastructure, innovation, sector-specific applications, workforce development, security, and implementation strategies.

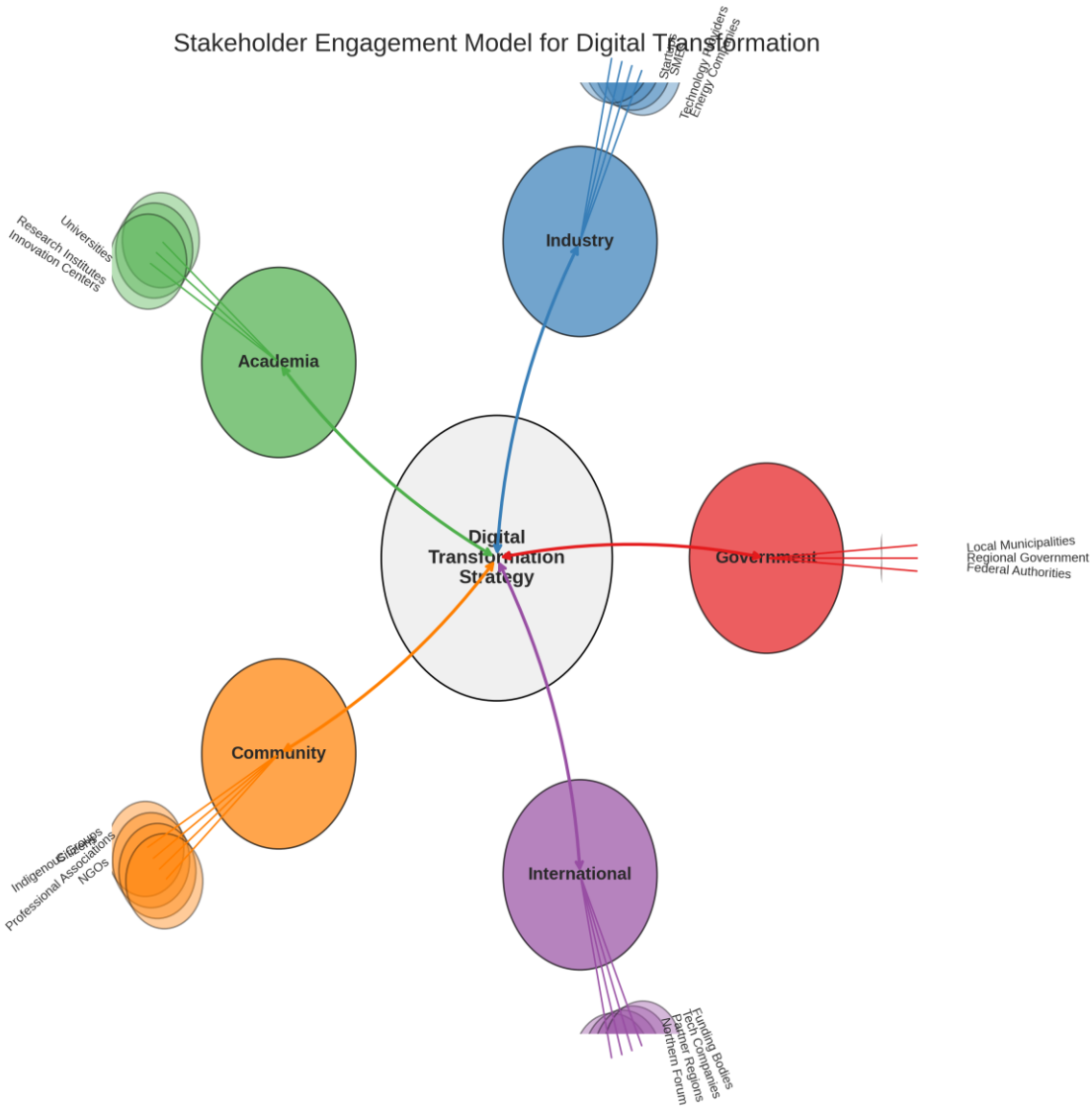
5.1 Strategic Framework

A **phased, adaptive framework** is recommended to guide the digital transformation journey of Khanty-Mansiysk Autonomous Okrug – Yugra (KhMAO–Yugra), ensuring a structured and responsive progression from current-state assessment to forward-looking implementation. This framework is built on a foundation of regional analysis while maintaining strong **alignment with national strategies** and 2030 goals.

- **Stage 1: Past Data/Situation Assessment:** Conduct a comprehensive review of **historical digital development data**, existing ICT infrastructure, human capacity, and service delivery quality to identify regional gaps and digital maturity levels. This baseline serves as the foundation for targeted planning and reflects prior evidence-based assessments.



- **Stage 2: Present Digital Transformation:** Define **policy measures and implementation roadmaps** based on the assessment, anchored in the **Strategic Goals for Digital Transformation of Yugra** including the agenda during the meeting of Public Council under the Department of Information Technologies and Digital Development of the Khanty-Mansiysk Autonomous Okrug – Yugra (Protocol of the meeting of May 25, 2021 No 65). Ensure strong alignment with national frameworks such as the **Digital Economy Program** and **Russia's AI Development Roadmap**. Implement **Key Performance Indicators (KPIs)**, institutional monitoring systems, and stakeholder engagement mechanisms to manage rollout and quality assurance across sectors.



- **Stage 3: Future Agenda and 2030 Vision:** Develop and promote **future-oriented digital priorities**, emphasizing sustainability, digital sovereignty, and the responsible deployment of emerging technologies (e.g., AI, quantum, blockchain). Align these efforts with **national 2030 targets** focused on:
  - Enhancing **quality of life** through digital public services
  - Ensuring **data trust and transparency**
  - Building **secure and resilient digital infrastructure**
  - Advancing **smart regional governance models**

  This strategic framework ensures that KhMAO's digital transformation is not only responsive to local needs but also positions the region as a proactive contributor to Russia's long-term digital development goals.

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5.2 Policy and Governance

Effective governance and supportive policies are crucial for steering digital transformation.

Goal Alignment and KPIs:

Define clear digital transformation policies aligned with KhMAO's regional development objectives as identified in the gap analysis. These policies must now be operationalized through the Department of Information Technologies and Digital Development, the designated authority as per Постановление Губернатора №137 от 11.12.2024.

Use the "IT Assets" (ИТ-Активы) centralized planning and documentation evaluation system to establish and track measurable KPIs, enabling evidence-based roadmap adjustments and ensuring implementation quality.

Stakeholder Engagement Model:

Implement a structured and periodic stakeholder engagement process led or coordinated by the Department. This should involve multi-tiered actors, including ministries, regional and local authorities, sectoral regulators (data, telecom, cybercrime), and civil society (consumer groups, universities, NGOs, and unions). This model ensures strategies remain inclusive, coherent, and responsive to both governance and community needs.

Regulatory Environment:

Promote an enabling regulatory environment by establishing AI regulatory sandboxes for innovation testing in priority sectors like energy and logistics, under oversight from the Department. These frameworks should balance experimentation with responsibility, starting with light-touch regulation and progressively adopting stricter rules in alignment with federal Russian law—particularly in high-risk applications. Public concerns about data privacy, transparency, and surveillance should be addressed through transparent governance and feedback mechanism.

5.3 Infrastructure Development

Robust and accessible digital infrastructure is the bedrock of transformation.

- **Enhancing Connectivity:** Address the digital divide by extending high-speed, reliable connectivity to rural areas, remote industrial sites, and underserved communities. This involves continuing the expansion of fiber-optic networks and upgrading mobile infrastructure (4G/LTE/5G), potentially leveraging federal programs and subsidies while exploring solutions to mitigate the high latency of satellite connections where they remain necessary.
- **Data Centers and Cloud Infrastructure:** Promote the development of modern, efficient, and sustainable data center infrastructure within the region. Address data localization requirements while encouraging the adoption of cloud services (public, private, hybrid) to enhance flexibility, scalability, and access to advanced computing resources. Explore partnerships with national providers (e.g., Yandex Cloud, SberCloud) while potentially fostering local cloud platform development.

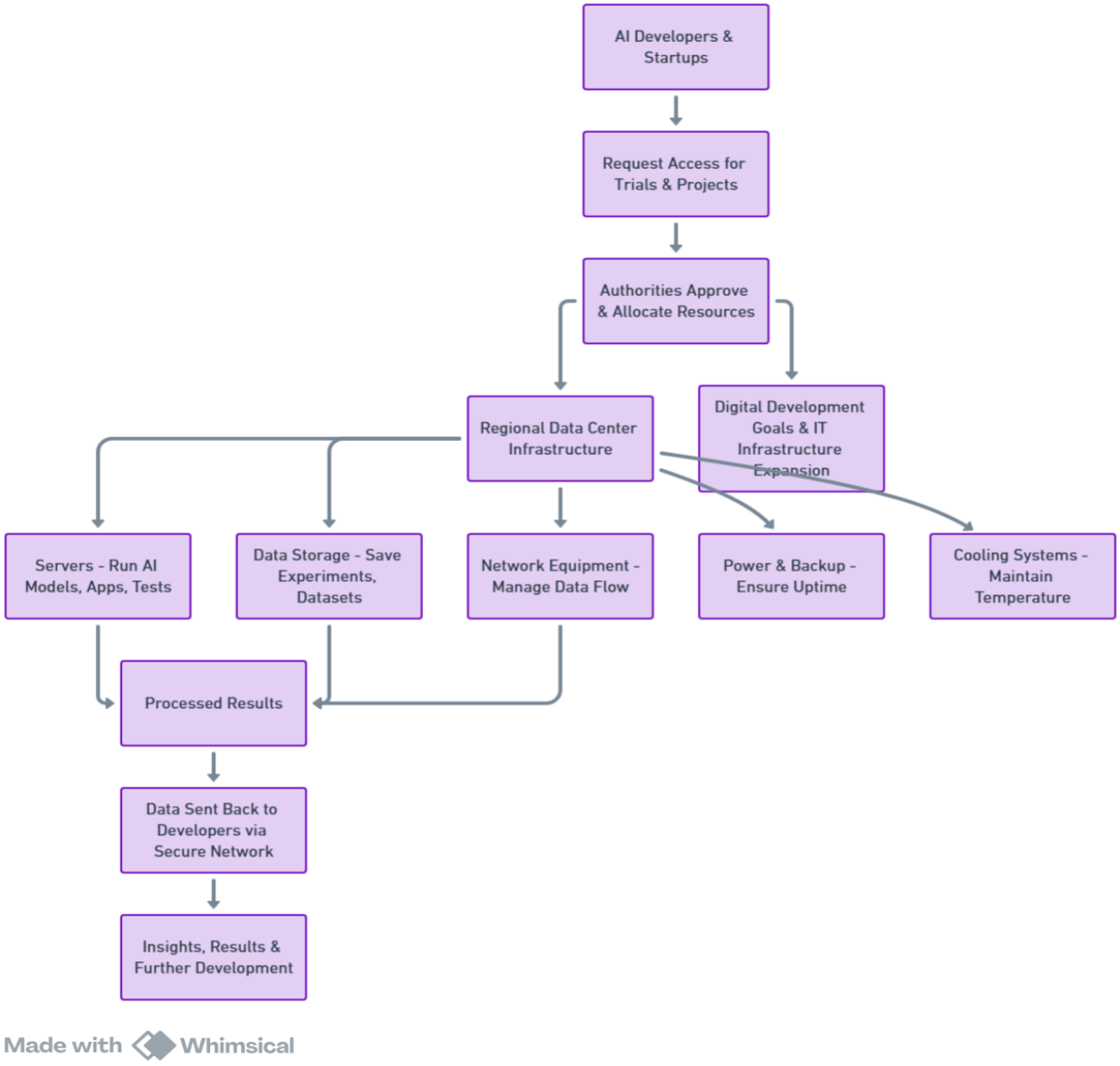
- **Remote Access:**
  Training delivered in 45 localities, including villages and indigenous communities, using public access centers with computer labs. It still need to improve connectivity in rural areas and support digital literacy programme.

5.4 Fostering Innovation

Recent initiatives indicate that in AI and Data Economy seminar, 25 regional digital leaders and 50 participant attended sessions on Digital Transformation Strategy aligning with federal interoperability standards. Conducting workshops can foster innovations. Creating a vibrant innovation ecosystem is key to leveraging technology effectively.

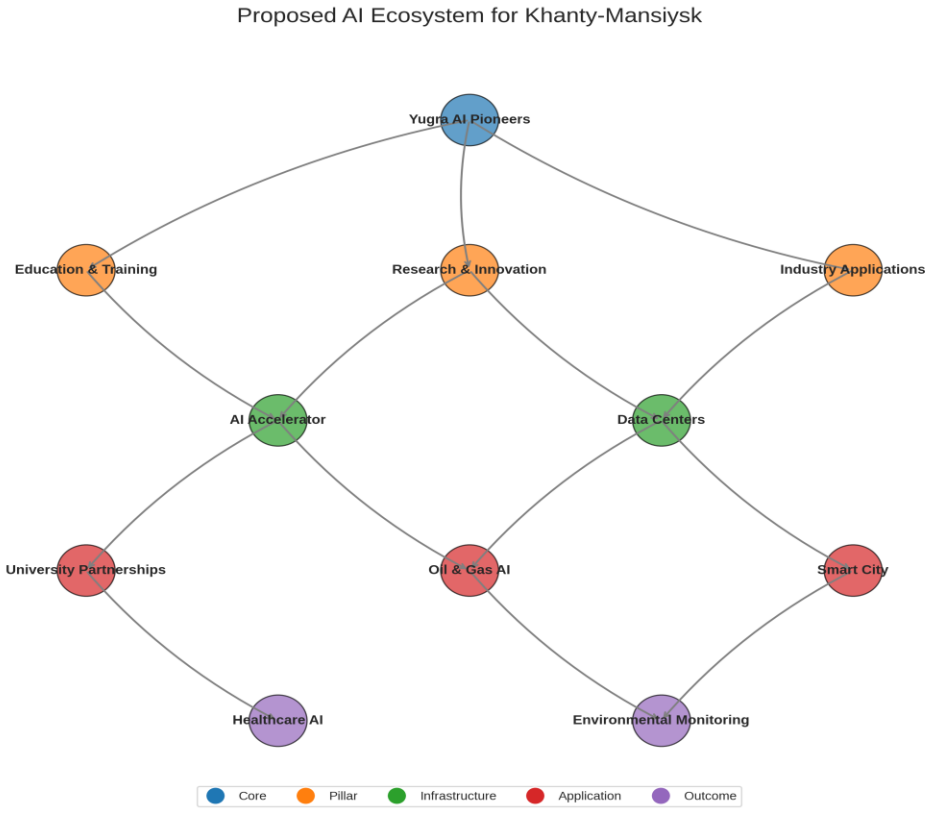
- **Testing and Experimental Facilities:** Expand on the region's participation in the **experimental legal regime for digital innovation** (*ПП РФ №462 от 24.03.2022*)—notably with **unmanned aerial systems (UAS)** already operational in KhMAO—to develop broader **AI and robotics testing environments**. Establish dedicated physical and virtual facilities that support cross-sector technology testing (AI, ML, robotics, quantum computing) in real-world Arctic and remote-area contexts, such as aerial cargo delivery and satellite imaging.

To acquire better results there is a need to develop testing and Experimental Facilities. A place we have designated for AI, Robotics, ML, and testing across various sectors (E.g. Healthcare, Agri, Communities, Manufacturing, Energy etc.) The target here is the Digitalization of Business and Public Services. The testing and experimental facilities includes both physical and virtual facilities. This will make sure that technology providers, research organizations, authorities can get support to test their latest AI-based soft/hardware technologies in real-world environments. As a part of this process, there is need of climate favorable as well as efficient and sustainable Data Center. Here is the diagram which reflects the idea of experimental facilities within the Digital Economy.



- **Supporting Startups:** Launch programs such as **"Yugra AI Pioneers,"** modeled after leading global (e.g., Singapore's AI Trailblazers) and domestic (e.g., Moscow's AI accelerators) examples. These initiatives should offer access to test zones (like those authorized under the UAS regime), mentorship, tax incentives, R&D grants, and advanced AI development tools (trustworthy AI, Model Context Protocols, synthetic data platforms). Special attention should be given to startups operating in logistics, energy, and healthcare in hard-to-reach territories.

This proposed initiative, "Yugra AI Pioneers," aims to transform KhMAO into a hub for AI innovation in Russia by leveraging its strengths and addressing current gaps in AI adoption. Launch AI Accelarator Programme, Enhancing AI Education and Training, Promote AI in public services. Collaboration with Russian companies, and other Chinese tech firms to leverage the potential of the region. The objective here is enabling local industries, government agencies, and educational institutions to develop and deploy their own AI solutions, while building a strong, sustainable pipeline of AI talent.



- **Industry Collaboration:** Build partnerships with Russian technology leaders (e.g., **Yandex, Sber AI, Gazprom Neft AI Lab**) and international companies to co-develop sector-specific AI solutions. Focus on logistics, energy, and environmental monitoring, particularly using technologies validated under the **UAS experimental regime**. Government coordination should ensure that these collaborations benefit from the legal flexibilities and data-sharing opportunities offered by the experimental frameworks.
- **Establishing Centers of Excellence/Innovation Hubs:** Establish regional centers focused on AI, cybersecurity, quantum communication, and digital logistics. These hubs should work closely with the **Department of Information Technologies and Digital Development of KhMAO** to consolidate technical expertise, drive regional R&D, and facilitate safe scaling of tested innovations into public and private services.
- **Exploring Emerging Technologies:** Initiate pilot projects on **quantum technologies** (e.g., secure quantum communication for administrative data flows) and **blockchain** (e.g., for contract validation in resource extraction zones). Lessons from UAS projects should inform the regulatory architecture for these new technology areas—supporting transparency, resilience, and connectivity in remote, Arctic-relevant use cases.

5.5 Sector-Specific Applications

The meeting of Public Council under the Department of Information Technologies and Digital Development of the Khanty-Mansiysk Autonomous Okrug – Yugra (Protocol of the meeting of May 25, 2021 No 65) included strategies of digital transformation, action plan and vision of **"Digital Yugra Platform"** as a backbone for interoperable data exchange. Plans for Smart Cities that includes digital twin for urban infrastructure, automated public utility monitoring, citizen engagement platforms for participatory governance has been an essential focus for implementing

strategy on digital transformation and Smart Society. For this, tailoring digital solutions to key regional sectors can drive significant value.

- **Energy Sector:** Leverage AI for predictive maintenance, pipeline inspection (e.g., using AI-driven drones), and oilfield optimization (e.g., using digital twins). Partner with industry leaders like Gazprom Neft for targeted R&D.
- **Healthcare:** Expand telemedicine services, especially for remote areas. Implement AI-powered clinical decision support tools to assist healthcare providers. Promote decentralized health data ownership, giving patients secure access and control over their records (similar to Estonia or Austria). Utilize remote monitoring via IoT devices for chronic disease management, potentially secured by blockchain. Ensure localized language interfaces for accessibility.
- **Transportation:** In addition to the public utility monitoring. Apply AI to optimize logistics, particularly for challenging conditions like ice-road trucking (predicting conditions, optimizing routes, driver assistance), drawing inspiration from practices in regions like Norway. Use AI and sensor technology for predictive road maintenance.
- **Environment:** Employ AI and satellite analytics for environmental monitoring, including tracking permafrost thaw, detecting methane leaks, and early wildfire detection and prevention.
- **Language Technologies:** Build an ecosystem to support the development and use of language technologies. This includes creating language models, attracting investment, and promoting AI-driven cultural programs to preserve linguistic diversity (including indigenous languages) and enhance digital inclusion.

5.6 Workforce Development, Capacity Building and Digital Skills

Developing a digitally skilled and future-ready workforce is essential for a **sustainable and sovereign digital economy** in Khanty-Mansiysk Autonomous Okrug – Yugra (KhMAO–Yugra). Strategic actions should leverage existing capacity-building structures while expanding inclusivity and relevance.

- **Addressing Skill Gaps and Expanding Access :**
  Identify and close gaps in critical areas such as **AI, data science, cybersecurity, and green/digital transition** competencies. In 2025, the **Department of IT** and **Yugra's IT Competency Center** will offer targeted programs including :
  - **AI Basics**
  - **Cybersecurity Fundamentals**
  - **Digital Government Tools**
  - Training on Russian IT platforms (e.g., AltLinux, AstraLinux)
    These programs are delivered via the **"Digital Citizen Yugra"** platform, which serves as the region's **centralized hub for registration, learning, and certification.** In 2024 alone, 14,116 residents completed self-paced online courses through the platform—highlighting its effectiveness and reach. The most popular courses were **"Mobile Applications" (2,813 participants) and "Smartphones for Beginners" (2,216 participants). In all 25,085 residents are trained (+12000 from 2023).** Considering Digital Competence metrics of 2024, 43,062 participated in the "Digial Dictation" skill assessment (vs. 19,985 in 2023)
  - Additionally, 203 residents completed in-person training programs, including:

- "Basics of Digital Literacy" (83 people)
- "Resources and Services of the Digital Economy" (66 people)
- "Basics of Safe Internet Use" (51 people)
- "Digital Curators for Public Access Centers" (3 people)

8,806 government and municipal employees also received training in digital competencies such as cybersecurity, data management, and AI in governance. Training initiatives for government employees support the **policy harmonization** goals. Demographic data shows strong participation **by women (79.8%), non-working pensioners (32.5%), and Indigenous minorities (3.4%),** with the largest age group being **51–60 years** and some learners aged up to 85.

The program's reach into 14 remote settlements in 2024—often through libraries and community centers—demonstrates a strong foundation for digital inclusion. The "Digital Citizen Yugra" model could serve as a replicable framework for other Northern Forum regions, promoting scalable, self-paced digital learning in Arctic and remote territories.

- **Educational Reforms and Industry-Relevant Skills:** Update university and vocational training curricula—especially in **engineering and applied sciences** tied to KhMAO's strategic sectors (e.g., oil & gas)—to include **practical AI applications** like robotics, digital twin technologies, and predictive maintenance. Form **academic partnerships** with national leaders such as **Skoltech and MIPT** to introduce hybrid and modular courses, including entrepreneurship and interdisciplinary project-based learning. Till now in the public Sector Digitalization, 695 government employees completed advanced training in Web design, information security, AI and Data Economy strategies. Additional, 50 municipal IT leaders underwent internships at the Yugra Research Institute of IT ("YUNII IT") to align local projects with regional digital goals. This programs are some evidences to see the progress in "Digital Governance" and other federal initiatives like Russia's 2030 AI Strategy.
- **Promoting Inclusivity and Indigenous Access:** Launch tailored programs to **increase participation of women** and underrepresented groups in AI and STEM fields, **using scholarships, mentoring, and networking opportunities.** Expand "**Digital Citizen Yugra"** services with multilingual support—including Indigenous languages—to ensure culturally inclusive and geographically equitable access. Include tools like **personalized skill diagnostics, CV and career support,** and **real-time job/learning trend mapping** to empower citizens.

This enhanced strategy ensures that KhMAO's digital workforce is equipped not only for today's demands but for the sustainable and sovereign digital economy of tomorrow.

5.7 Security, Privacy, and Trust

Ensuring security and building public trust are paramount.

- **Cybersecurity Measures:** Establish robust cybersecurity infrastructure and protocols, potentially including regional Security Operation Centers (SOCs). Focus on cyber resilience – the ability to detect, prepare for, respond to, and recover from large-scale cyber threats and attacks.

- **Addressing Malicious Use of AI (MUAI):** Recognize the risks associated with MUAI. Establish teams and processes, potentially leveraging AI systems within Centers of Excellence, to assess AI capabilities and threats. Maintain control over access to sensitive information and its processing, analysis, and dissemination.
- **Building Public Trust:** Launch public awareness campaigns to educate citizens about the benefits and risks of new technologies like AI, address privacy concerns, and build confidence in digital transformation initiatives.

5.8 Funding and Implementation

Securing resources and ensuring effective implementation are critical for success.

- **Leveraging Federal Funds and Incentives:** In addition to national strategic programs like **Russia's 2030 AI Development Strategy**, KhMAO should proactively seek inclusion in funding schemes authorized under *ПП РФ №1598 от 05.12.2019*. These include **federal subsidies** and **low-interest loans (1–5%)** for digital transformation initiatives utilizing certified **Russian IT solutions**. Priority projects could include the development of **local AI infrastructure**, **sovereign cloud data centers**, and **regionally relevant platforms** for energy, transport, and public services.
- **Promoting Joint Ventures, MOUs, PPPs:** Strengthen public-private engagement by forming **Joint Ventures (JVs)**, **Memoranda of Understanding (MOUs)**, and **Public-Private Partnerships (PPPs)** with national tech firms and infrastructure providers. These mechanisms can facilitate shared funding, knowledge exchange, and risk management, enabling the region to undertake large-scale digital transformation projects more efficiently. Ensure such partnerships prioritize technological sovereignty by aligning with Russian digital standards and leveraging domestic platforms aligned with regional goals where possible.

6. Conclusion

6.1 Summary of Findings

The assessment conducted by the International Expert Group on Regional IT Agenda reveals that the Khanty-Mansiysk Autonomous Okrug – Yugra possesses a robust foundation for digital transformation, characterized by high levels of basic connectivity, particularly household broadband access, and significant adoption of specific enterprise technologies like ERP and GIS, primarily driven by the needs of its dominant energy sector. However, the region faces challenges in translating these strengths into broader, more diversified digital development. Key limitations include a nascent local AI ecosystem, persistent data silos, infrastructure bottlenecks in remote areas (particularly concerning speed and latency for advanced applications like IoT and cloud), a gap in advanced digital skills within the workforce despite good foundational literacy, and relatively slower adoption of cloud computing compared to its potential.

6.2 Reiteration of Recommendations

To address these challenges and capitalize on opportunities, this report puts forth a multi-pronged strategy. Key strategic priorities include: strengthening policy and governance frameworks through clear goal-setting and inclusive stakeholder engagement; enhancing digital infrastructure with a focus on bridging the urban-rural divide and promoting modern data

center/cloud solutions; actively fostering innovation by establishing testing facilities, supporting startups (e.g., "Yugra AI Pioneers"), promoting industry collaboration, and exploring emerging technologies; tailoring digital applications to critical sectors like energy, healthcare, transport, and environment; investing significantly in workforce development to cultivate advanced digital skills and ensure inclusivity; and bolstering cybersecurity measures while building public trust in digital transformation initiatives. Effective implementation hinges on leveraging federal funding and fostering strong public-private partnerships. Additionally, expansion of "Digital Citizen Yugra" portal and develop new curricula for AI/Cloud computing.

6.3 Future Outlook

By strategically implementing these recommendations, Khanty-Mansiysk Autonomous Okrug – Yugra has the potential to significantly advance its digital transformation journey. The vision is for KhMAO to evolve into a digitally sovereign, resilient, and competitive region, not only within the Russian Federation but also as a model for sustainable digital development in Northern and Arctic territories. Achieving this requires sustained commitment, collaborative effort from all stakeholders, and adaptive management to navigate the rapidly evolving technological landscape. The International Expert Group on Regional IT Agenda remains committed to supporting KhMAO in realizing this ambitious but achievable future.

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