

**RECONCEPTUALIZING NATIONAL INNOVATION SYSTEMS IN TRANSITIONAL ECONOMIES: INSTITUTIONAL EVOLUTION, SYSTEMIC COORDINATION FAILURES, AND STRATEGIC POLICY DIRECTIONS IN THE CASE OF UZBEKISTAN**

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**Abstract:** Innovation is a core driver of sustainable economic growth and competitiveness. In transitional economies, effective National Innovation Systems (NIS) are critical for enabling knowledge-based development. This paper examines the evolution, challenges, and policy directions of Uzbekistan's NIS within a comparative innovation systems framework. It traces four development stages—legal foundations, institutional structuring, infrastructure expansion, and strategic integration—revealing systemic barriers including institutional fragmentation, weak coordination, information asymmetries, and human capital gaps.

Drawing on national policies and global best practices, the study proposes strengthening legal incentives, institutional integration, information infrastructure, human capital, and international cooperation. The findings highlight how state-driven NIS models must transition toward networked, trust-based, and information-rich ecosystems to accelerate innovation-led development.

**Keywords:** National Innovation System, Uzbekistan, innovation policy, institutional development, coordination failure, human capital, information systems, transitional economies.

**Introduction.** Innovation is a key driver of sustainable economic growth, global competitiveness, and societal welfare. In the knowledge economy, nations are distinguished by their capacity to generate, diffuse, and apply new knowledge. Innovation, however, occurs within networks of institutions, actors, and policies that form a National Innovation System (NIS).

Emerging in the late 1980s and early 1990s, the NIS concept shifted attention from linear R&D models to interactive and institutional processes (Freeman, 1987; Lundvall, 1992; Nelson, 1993). Innovation performance depends on the strength of linkages among universities, firms, government, finance, and intermediaries (Feinson, 2003; UNESCWA, 2022).

While advanced economies such as Finland, South Korea, and Singapore have benefited from coherent innovation systems, transitional contexts face fragmentation, weak institutions, and limited absorptive capacity (Lundvall et al., 2009; Intarakumnerd & Chaminade, 2011).

In Uzbekistan, innovation has become a strategic priority. Despite major legal and institutional reforms, the system remains hindered by structural gaps, weak coordination, and human capital constraints. This makes Uzbekistan a critical case for examining how NIS frameworks can be adapted in transitional economies.

**Literature Review and Theoretical Background.** Innovation systems theory has become a central framework for understanding how technological change drives economic growth, especially in knowledge-based economies. The National Innovation System (NIS) concept emphasizes institutional interactions, systemic learning, and feedback loops that foster innovation (Freeman, 1987; Lundvall, 1992; Nelson, 1993). Unlike linear innovation models, the NIS approach focuses on network relationships and institutional complementarities. Freeman's study of Japan (1987) and Lundvall's concept of interactive learning (1992) showed how interactions between firms, research institutions, and the state shape innovation performance. Nelson (1993) extended

this with comparative analyses, highlighting how institutional configurations and policy frameworks determine technological trajectories.

In Uzbekistan, innovation system development reflects typical transitional patterns. Since independence, the government has introduced legal reforms, created innovation agencies, technoparks, and research centers. Key milestones include the establishment of the Coordinating Committee for Science and Technology (2006), the Technology Transfer Agency (2008), and the Ministry of Innovative Development (2017). However, operational integration remains weak, with limited coordination among institutions and between the public and private sectors. As research shows, institution-building alone is insufficient; effective innovation systems require connectivity, information flows, incentives, and human capital strategies (Intarakumnerd & Goto, 2018; Chaminade & Lundvall, 2014).

The evolution of Uzbekistan's NIS has unfolded in several stages.

- Early foundation (1990s): The 1992 Presidential Decree on State Support for Science and Innovation and subsequent grant mechanisms established innovation as a national priority, though efforts remained fragmented and science-focused.
- Institutional structuring (2000s): New agencies improved coordination and technology transfer, signaling a shift toward commercialization.
- Infrastructure expansion (2010s): Initiatives such as the High Technology Center (2011) and technoparks aimed to integrate research, education, and industry.
- Strategic integration (2020s): Under the "Uzbekistan-2030" program, innovation, science, and digitalization became pillars of modernization. Youth programs like TechnoWays and Technovation Girls were launched, and intellectual property and venture financing frameworks strengthened.

Although the legal and institutional architecture has expanded significantly, the NIS remains transitional. Persistent challenges include institutional fragmentation, limited private sector engagement, and insufficient systemic connectivity — common issues in state-driven innovation systems in developing economies (Chaminade & Edquist, 2010).

Current Organizational and Institutional Challenges of the National Innovation System in Uzbekistan. Although Uzbekistan has made notable progress in building the legal and institutional foundations for innovation, its national innovation system remains transitional. Legal frameworks, agencies, and infrastructure exist, but effectiveness is constrained by fragmentation, weak coordination, and limited innovation activity—challenges typical of many developing economies (Chaminade & Edquist, 2010; Lundvall et al., 2009; Intarakumnerd & Chaminade, 2011).

A major issue is overlapping functions and poor coordination among innovation institutions. Technoparks, incubators, technology transfer centers, and research institutes operate with unclear mandates, causing duplication, inefficient resource use, and weak strategic focus. Horizontal linkages between ministries, universities, and industry remain limited. Despite improved centralized governance through the Ministry of Innovative Development, inter-agency cooperation is weak, and activities function in silos, undermining systemic integration (Nelson, 1993; Freeman, 1987). Private sector engagement is minimal, leaving research outputs undercommercialized.

The absence of a unified information infrastructure further hinders progress. Without a national platform for R&D, technologies, or innovation networks, information asymmetries persist, reducing collaboration, discouraging investment, and slowing diffusion (Feinson, 2003; Chaminade & Edquist, 2006).

Human capital also poses constraints: low motivation among young researchers, brain drain, an aging workforce, and weak incentives limit system dynamism. Entrepreneurial culture and risk

tolerance are low, and innovation is often perceived as a state-led activity. Limited education and international exposure exacerbate these behavioral barriers, delaying NIS maturation (Intarakumnerd & Goto, 2018; Lundvall et al., 2009).

Together, these structural, informational, and human capital weaknesses reflect systemic coordination failure. Institutional components exist but weak interconnections lead to slow commercialization, underused capacity, and fragmented policy implementation—hallmarks of transitional innovation systems (Chaminade & Lundvall, 2014; Intarakumnerd & Chaminade, 2011).

Policy and Strategic Directions for Strengthening the National Innovation System of Uzbekistan. Addressing the organizational and institutional weaknesses of Uzbekistan’s innovation system requires coherent, multidimensional policy measures. International experience shows that fragmented interventions are rarely effective; successful systems rest on coordinated legal, organizational, informational, and human capital strategies (Freeman, 1987; Lundvall, 1992; Chaminade & Edquist, 2010).

A major weakness lies in limited demand-side drivers and weak economic incentives for private sector participation. To address this, the state should:

- Expand tax incentives and grants for startups and industrial R&D;
- Introduce legal status for “innovation buyers” to ease public and private procurement of domestic innovations;
- Strengthen IP protection and enforcement;
- Enhance legal frameworks for venture capital and alternative investment.

Such measures would better align supply-side capacity with commercialization (Chaminade & Edquist, 2006; Intarakumnerd & Goto, 2018).

Fragmentation among technoparks, incubators, research institutes, and ministries calls for stronger institutional integration. Priorities include:

- Clearly differentiating institutional mandates;
- Formal coordination mechanisms among ministries, academia, and industry;
- Strengthening the strategic steering role of the Ministry of Innovative Development;
- Developing regional innovation clusters.

These steps improve resource efficiency and foster collaboration (Feinson, 2003; Chaminade & Lundvall, 2014).

Information asymmetry remains critical. A National Innovation Information System (NIIS) should centralize data on R&D, technologies, actors, and funding opportunities. Public access and regional integration would enhance transparency and participation, accelerating innovation cycles (Lundvall et al., 2009; Intarakumnerd & Chaminade, 2011).

Human capital remains a bottleneck. Policy measures should include:

- Youth innovation clubs and incubators in universities;
- Honorary titles and incentives to raise innovation’s social prestige;
- Scholarships and grants for young researchers;
- International exchange programs;
- Strengthening innovation-oriented curricula.

These steps address behavioral and skill gaps and reflect global best practices (Chaminade & Edquist, 2010; Intarakumnerd & Goto, 2018).

Finally, global integration can accelerate NIS development. Partnerships with UNDP, KOICA, GIZ, Islamic Development Bank, and World Bank can support capacity building, technology transfer, joint research, and international exposure. Such linkages help overcome domestic constraints and embed Uzbek actors in global value chains (Chaminade & Lundvall, 2014; Freeman, 1987).

Conclusion. The development of an effective national innovation system (NIS) is a strategic priority for Uzbekistan as it seeks to transition toward a knowledge-based economy and enhance global competitiveness. Over the past three decades, the country has built a legal and institutional framework for science, technology, and innovation. Key milestones include the 1992 Presidential Decree on State Support for Science and Innovation, the 2006 Coordinating Committee for Science and Technology, the 2008 Technology Transfer Agency, and the 2017 establishment of the Ministry of Innovative Development.

However, institutional existence alone does not ensure system functionality. Uzbekistan's NIS remains constrained by structural fragmentation, weak coordination, information asymmetries, human capital challenges, and systemic failures that limit commercialization and private sector engagement. These issues reflect common transitional economy patterns and highlight the gap between formal architecture and operational effectiveness.

To address this, strategic actions should focus on stronger legal and economic incentives, institutional integration, development of a National Innovation Information System, human capital investment, and international partnerships to accelerate learning and integration.

The Uzbek case demonstrates that while early NIS development is often state-driven, long-term sustainability requires network-based governance, robust information infrastructure, and empowered human capital. This trajectory aligns with experiences of countries such as Finland, South Korea, and Singapore. Moving from institution-building to system-building—by strengthening actor linkages and aligning legal and market mechanisms—will be critical for fostering innovation flows between research, industry, and society.

If implemented effectively, these measures can accelerate Uzbekistan's transition toward a dynamic, competitive, and knowledge-based economy, strengthening its role in global innovation networks.

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