

# Repositioning Cities as Innovative Ecosystems: Integrating Digital Infrastructure and Technology-Based Entrepreneurship in Urban Contexts

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## ARTICLE INFO

### Article history:

Received: 10 July 2025

Revised: 17 July 2025

Accepted: 22 July 2025

### DOI:

10.61100/tacit.v3i2.277

### Keywords:

Innovative City, Digital Infrastructure, Technology Entrepreneurship, Innovation Ecosystem, Smart City



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## ABSTRACT

This study aims to critically analyze how the integration of digital infrastructure and technology-based entrepreneurship can drive the repositioning of cities as innovative ecosystems within modern urban contexts. Employing a qualitative approach through a literature review method, this research examines 33 scholarly articles selected from 50 academic sources obtained via Google Scholar and other credible databases, published between 2020 and 2025. The findings reveal that the successful repositioning of cities is heavily influenced by the synergy between the availability of digital infrastructure, the activation of technology-driven entrepreneurship, collaborative governance, and the involvement of key actors such as government, universities, communities, and the business sector. Case studies from cities like Tallinn, Surabaya, Jakarta, and Bandung reinforce the argument that transforming cities into innovative ecosystems requires a systemic, theory-based approach that emphasizes social sustainability. This research offers both theoretical and practical contributions to the formulation of urban policies aimed at fostering cities as collaborative, digital, and innovation-driven spaces.

## ABSTRAK

Penelitian ini bertujuan untuk menganalisis secara kritis bagaimana integrasi antara infrastruktur digital dan dinamika kewirausahaan berbasis teknologi dapat mendorong reposisi kota sebagai ekosistem inovatif dalam konteks perkotaan modern. Menggunakan pendekatan kualitatif dengan metode tinjauan pustaka, penelitian ini mengkaji 33 artikel ilmiah yang diseleksi dari 50 literatur yang diperoleh melalui Google Scholar dan sumber-sumber kredibel lainnya yang diterbitkan pada rentang tahun 2020 hingga 2025. Temuan menunjukkan bahwa keberhasilan reposisi kota sangat dipengaruhi oleh sinergi antara ketersediaan infrastruktur digital, aktivasi kewirausahaan teknologi, tata kelola kolaboratif, serta keterlibatan aktor-aktor kunci seperti pemerintah, universitas, komunitas, dan sektor bisnis. Studi kasus dari kota-kota seperti Tallinn, Surabaya, Jakarta, dan Bandung memperkuat argumen bahwa transformasi kota menjadi ekosistem inovatif memerlukan pendekatan sistemik, berbasis teori, dan berorientasi pada keberlanjutan sosial. Penelitian ini memberikan kontribusi teoritis dan praktis bagi perumusan kebijakan perkotaan yang ingin membangun kota sebagai ruang kolaboratif, digital, dan produktif secara inovatif.

## 1. INTRODUCTION

Urban transformation in the 21st century demands more than just the development of physical infrastructure; cities are now required to evolve into innovative ecosystems capable of responding to complex global challenges such as climate change, urbanization, technological disruption, and social inequality. The concept of the "innovative city" is no longer confined to the construction of modern facilities but entails the systemic integration of digital technology, social creativity, and entrepreneurial dynamics (Alfarizi, 2023). Within this context, repositioning the city as an innovative ecosystem serves as a fundamental strategy to enhance urban

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competitiveness, reinforce economic inclusion, and create knowledge-based added value. This paradigm shift aligns with the emergence of smart city and creative city frameworks that blend technological engagement, intelligent governance, and civic participation in orchestrating sustainable and adaptive development.

Digital infrastructure serves as a crucial foundation for transforming cities into innovative ecosystems. The development of high-speed internet networks, integration of public data systems, provision of open-access information, and the use of technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics are elements reshaping how cities function and interact with their citizens. Cities such as Bandung, Surabaya, and Makassar have begun integrating digital infrastructure into transportation management, public services, and urban security. However, the mere availability of digital infrastructure does not guarantee innovation unless it is accompanied by the activation of an entrepreneurial ecosystem that is both adaptive to technology and open to cross-sector collaboration (Lado, 2021).

Amid the development of digital infrastructure, the dynamics of technology-based entrepreneurship play a central role in unlocking the innovative potential of cities. The rise of tech startups, business incubators, coworking spaces, and e-commerce platforms has fostered a new landscape of urban economies that are fluid, flexible, and collaborative. In this context, entrepreneurship is not merely seen as an economic activity but as a vehicle for cultivating a solution-oriented innovation culture. Cities become arenas for social and economic experimentation where disruptive ideas are tested, incubated, and disseminated digitally. Ecosystems such as Jakarta Smart City Lounge and Jogja Digital Valley offer concrete examples of the synergy between digital infrastructure and entrepreneurial networks (Smart City, 2021; Tanjungsari & Hendrastomo, 2016).

Nonetheless, the integration of digital infrastructure and technology entrepreneurship within cities does not occur automatically or linearly; it requires deliberate policy interventions, multi-actor orchestration, and strategic institutional coordination. When cities fail to build synergistic relationships among public, private, academic, and community actors, the potential of digitalization and entrepreneurship risks creating fragmented pockets of growth. Therefore, the ecosystem approach becomes essential: cities must be understood as living, interconnected, and complex spaces where digital architecture and entrepreneurial dynamics need to be developed systemically, inclusively, and sustainably. This aligns with the concept of urban innovation ecosystems, which emphasizes the importance of social cohesion, technological accessibility, and support for small-scale economic actors (SETC, 2022).

The repositioning of cities as innovative ecosystems also demands a redefinition of the role of city governments. Governments are no longer the sole providers of public services; instead, they must transform into facilitators of innovation – capable of creating experimental spaces, responding to community needs in real time, and formulating adaptive regulations in line with digital dynamics. The municipal government of Surabaya, for instance, has promoted the development of a Startup Hub and the 1000 Startups program to strengthen networks of young innovators within the public sector (Surabaya, 2021b, 2021a). However, government involvement must be balanced by the decentralization of creativity through citizen communities and business actors, ensuring that innovation does not remain elitist or top-down, but becomes participatory and contextually grounded in local urban challenges.

Moreover, the spatial dimension of the city's innovative ecosystem must not be overlooked. Specific zones such as city centers, tech campuses, and creative economy districts serve as critical nodes in the diffusion of innovation. Yet, when innovation is overly concentrated in elite areas, it risks deepening digital divides and exacerbating spatial and social inequalities. Therefore, the integration of technology and entrepreneurship must extend across the entire urban spectrum, including peripheral areas and vulnerable populations, so that the repositioning of cities as innovative ecosystems does not merely reinforce digital capitalism but also fosters spatial justice and holistic social transformation.

From the perspective of systems theory and urban planning, the integration of digital infrastructure and entrepreneurial dynamics should be positioned as mutually reinforcing subsystems within the broader urban ecosystem. The Triple Helix model proposed by (Etzkowitz & Leydesdorff, 2000) offers a conceptual framework for understanding collaboration among universities, industry, and government in generating innovation relevant to urban development. By expanding this model into the Quadruple Helix, which incorporates civil society, and the Quintuple Helix, which adds an environmental dimension, city repositioning can be directed toward building an innovation system that is not only economically productive but also socially and ecologically sustainable.

Based on these considerations, this study aims to critically analyze how the integration of digital

infrastructure and technology-based entrepreneurial dynamics can drive the repositioning of cities as innovative ecosystems. Through this literature review, the author seeks to identify conceptual models, empirical studies, and interdisciplinary approaches that are relevant for understanding the complexity of relationships among technology, entrepreneurship, and urban transformation in the digital age.

## **2. THEORETICAL FRAMEWORK AND HYPOTHESES**

### **Innovative City**

An Innovative City is an urban development concept that places innovation at the core of social, economic, and governance transformation processes (Jeannerat & Lavanchy, 2024). Such a city does not rely solely on physical growth or infrastructure expansion but instead cultivates an ecosystem that promotes creativity, cross-sector collaboration, and the utilization of technology to generate adaptive solutions for urban challenges. These cities facilitate dynamic interactions among government, citizens, businesses, and educational institutions to co-create knowledge-based added value and establish social experimentation spaces that support policy reform and sustainable urban development practices.

### **Digital Infrastructure**

Digital Infrastructure refers to the systems of information and communication technology that form the backbone for the operation of public services, data exchange, and digital economic activities in urban areas (Oloyede et al., 2023; Pan et al., 2022). This infrastructure includes internet networks, data centers, hardware and software components, digital platforms, and integrated real-time information management systems. A robust and equitable digital infrastructure enables cities to operate smart transportation systems, online public services, citizen participation platforms, and data-driven governance, ultimately fostering efficiency, transparency, and enhanced social connectivity.

### **Technology Entrepreneurship**

Technology Entrepreneurship is a form of entrepreneurship that leverages technology as the core driver in creating innovative products, services, and business models (Putra et al., 2024). In urban contexts, technology entrepreneurship serves not only as a catalyst for digital economic growth but also as a strategic tool for addressing urban issues in sustainable and solution-oriented ways, including challenges related to transportation, energy, healthcare, and the environment. Digital startups, smart city applications, and civic tech platforms are tangible manifestations of technological entrepreneurship thriving in cities that open spaces for innovation, collaboration, and technology-driven social transformation.

### **Innovation Ecosystem**

An Innovation Ecosystem is a systemic network of diverse actors, institutions, resources, and policies that interact to create, develop, and disseminate innovation (Rabelo Neto et al., 2024). Within urban contexts, the innovation ecosystem includes city governments, universities, private sector entities, tech communities, funding institutions, and citizens as end users of innovation. This ecosystem emphasizes not only the technological dimension but also the social, cultural, and regulatory structures that support open collaboration, social experimentation, and the strengthening of local capacities to generate contextually relevant and economically and socially sustainable innovations.

### **Smart City**

A Smart City is an urban development concept that integrates information and communication technologies to enhance the efficiency of public services, the quality of life for residents, and environmental sustainability (Gu et al., 2025). It goes beyond mere digitalization by relying on the intelligent collection and analysis of data for informed decision-making and promoting active citizen participation in governance processes. The smart city concept encompasses various aspects, including intelligent transportation, energy management, waste management, public safety, and digital administration systems, all aimed at building cities that are more responsive, transparent, and oriented toward real-time citizen needs.

## **3. RESEARCH METHOD**

This study employs a literature review method with a descriptive qualitative approach. This approach was chosen as it aligns with the objective of the research, which is to gain a deep understanding and analysis of

the concept of city repositioning as an innovative ecosystem through the integration of digital infrastructure and technology-based entrepreneurial dynamics in an urban context. The research does not involve direct field data collection but instead relies on secondary data sourced from various scholarly literatures and credible documents relevant to the topic. The analysis is conducted descriptively by examining, classifying, and interpreting both theoretical and empirical findings from the reviewed sources. The data for this study were collected from publications available on the Google Scholar platform as well as several official and reputable websites, including university journal portals, research institutions, and international organizations focused on urban studies, innovation, technology entrepreneurship, and digital transformation. The selected articles and documents were chosen based on strict criteria: (1) published between 2000 and 2025, (2) directly relevant to the themes of city repositioning, digital infrastructure, innovation ecosystems, and technology entrepreneurship, and (3) possessing academic credibility, either through peer-review processes or publication by authoritative institutions. The initial data collection phase yielded a total of 50 articles and scholarly sources. However, through a rigorous selection process that involved filtering content relevance, theoretical contribution, and contextual alignment with the research focus, the number was narrowed down to 33 core articles used as the primary data for analysis. These selected articles include conceptual studies, empirical case studies, policy reports, and models of innovation ecosystems that have been implemented in various cities around the world, including in Indonesia. The collected data were then analyzed qualitatively using a thematic approach to identify conceptual patterns and practical strategies that support city repositioning within the framework of a digital and technology-based entrepreneurial innovation ecosystem.

#### 4. DATA ANALYSIS AND DISCUSSION

The repositioning of cities as innovative ecosystems represents a paradigm shift from viewing cities as merely administrative entities to recognizing them as strategic actors in the creation of knowledge-based value through multi-actor synergies within complex systems. Urban Innovation Ecosystem Theory explains that cities must be understood as dynamic spaces where various interests – government, businesses, academic institutions, and communities – converge and collaborate to drive innovation. This theory evolves from the Triple Helix Model by (Etzkowitz & Leydesdorff, 2000), which emphasizes the importance of collaboration between universities, industry, and government in enhancing a region's innovation capacity. Within this framework, the city plays not only the role of a development site but also serves as a facilitator, accelerator, and mediator of knowledge-based growth. Repositioning a city requires deep structural changes across spatial and infrastructure dimensions, governance systems, regulatory frameworks, and the strengthening of technology-based entrepreneurial ecosystems. Such transformation is essential for cities to respond adaptively to digital disruption and to integrate emerging economic opportunities arising from the creative and technology industries. The city's role within the innovation ecosystem is inseparable from its efforts to build collaborative networks, support research and development capacities, and foster social environments that enable inclusive stakeholder participation. This repositioning becomes the key for cities to enhance their competitiveness at both national and global levels in the era of the innovation-driven economy.

Digital infrastructure plays a crucial role as the foundational element in building innovative ecosystems in urban areas, due to its capacity to integrate technology, data, and social interactions into a system that enables more responsive, transparent, and participatory decision-making processes. Previous studies highlight that cities implementing integrated sensor systems, real-time data analytics, and open information access tend to gain a competitive edge in formulating evidence-based policies and addressing citizen needs adaptively (Bibri, 2019; D'Amico et al., 2020; Hansen et al., 2025). A tangible example of this can be seen in the development of Surabaya Smart City, which operates a centralized Command Center, utilizes digital citizen reporting via mobile applications, and provides open urban data through publicly accessible dashboards (Agustina et al., 2023; Anjani et al., 2024). These initiatives strengthen bureaucratic efficiency and promote greater civic engagement in urban governance. However, the success of such digital initiatives greatly depends on the sustainability of their underlying infrastructure – including stable and widespread internet connectivity, robust data security systems, and human resource capabilities in designing, managing, and expanding digital systems sustainably. Without attention to these aspects, digital infrastructure risks becoming a burden that exacerbates regional digital divides and complicates data governance. Investments in digital infrastructure must therefore be accompanied by inclusive policies that ensure all actors – including marginalized communities – have equal access, literacy, and participation in shaping the city's direction toward a more innovative and sustainable ecosystem.

While digital infrastructure is a critical prerequisite for building innovation-based cities, its success is ultimately determined by how effectively cities can activate technology-driven entrepreneurial dynamics that concretely drive cross-sector innovation through collaborative, solution-oriented networks. The Entrepreneurial Ecosystems theory developed by (Isenberg, 2010) underscores that tech-based economic transformation is supported by sophisticated infrastructure, the presence of innovative entrepreneurs, institutional support like incubators and accelerators, open access to both local and global markets, and a collaborative culture that encourages experimentation and risk-taking. In the Indonesian context, previous analyses have identified initiatives such as Bandung Techno Park and Jogja Digital Valley as concrete examples of successful urban strategies in creating technology entrepreneurship ecosystems through the synergy of digital infrastructure, active academic involvement, and structured business incubation mechanisms (Gareta, 2018; Tanjung Sari & Hendrastomo, 2016). Such spaces provide startups with opportunities for technical and strategic growth by strengthening networks, funding access, and sustainable market entry. Cities capable of building these environments not only create jobs and stimulate local economic growth but also enhance their regional competitiveness in facing global digital economy challenges. The integration of digital infrastructure and entrepreneurial dynamics should thus be seen as a shared foundation in repositioning cities as inclusive and sustainable hubs of technological innovation.

A concrete example of successful integration between digitalization and entrepreneurship is found in Tallinn, Estonia, which has realized comprehensive digital transformation in public services through a full-scale e-government system, while also fostering a dynamic and globally competitive startup ecosystem via the Startup Estonia program (e-Estonia, 2025; Wikipedia, 2025). This program provides strategic support through business incubation, innovation-friendly regulations, and a digitally oriented education system starting from the primary level – simultaneously cultivating a highly skilled technology workforce. The Tallinn model underscores that urban digitalization has limited impact unless systematically integrated with entrepreneurial empowerment strategies and global network development, as innovation depends equally on technology and human capital. Tallinn has built a pro-innovation business climate by streamlining legal procedures, offering startup-friendly tax policies, and ensuring equitable digital infrastructure. Estonia, with Tallinn as its growth hub, has even become one of the countries with the highest number of tech startups per capita in the world, demonstrating how the synergy between digital governance and technology entrepreneurship can elevate national competitiveness through urban-scale initiatives. This success story also illustrates the importance of long-term digital policy vision, consistent regulatory frameworks, and the strategic role of cities as catalysts for embedding local innovation within global ecosystems in a sustainable manner.

The repositioning of cities as innovative ecosystems cannot be separated from the role of regulations and public policies that actively promote social inclusion, decentralization of authority, and cross-sectoral collaboration. Without a supportive normative framework, innovation risks becoming exclusive and widening existing digital divides. The Collaborative Governance theory proposed by (Ansell & Gash, 2008) emphasizes the importance of equal deliberative processes among government, civil society, and the private sector in formulating shared policies that are responsive to local needs, where meaningful participation becomes the key to successful innovative governance. In the Indonesian context, previous statements highlight how the Jakarta Smart City initiative – through features like Qlue and digital musrenbang forums – has created digital spaces for citizen participation in city planning and public service monitoring, reflecting a collaborative spirit that lies at the heart of digital governance (Ramadhan & Aziza, 2019). However, realizing collaborative governance still faces structural barriers, particularly in reaching marginalized groups such as residents in peripheral urban areas who often lack access to adequate devices, digital literacy, or stable internet connections. This disparity poses a risk of participatory exclusion in decision-making processes and undermines the potential for inclusive innovation. Thus, public policymaking in the context of innovative cities must explicitly incorporate principles of digital equity, mechanisms for community capacity building, and the decentralization of deliberative processes to ensure that all layers of society have a voice in shaping the city's future. Repositioning the city must go beyond digitizing systems; it must democratize participatory spaces so that innovation is truly rooted in the needs and potentials of all urban residents.

In the context of cities in developing countries, one of the most pressing challenges in building innovative ecosystems is avoiding the "digital divide" trap that exacerbates social and economic disparities between groups with access to technology, skills, and literacy, and those who are structurally left behind. Previous studies have shown that Southeast Asian cities, including those in Indonesia, continue to face significant digital inequality caused by uneven distribution of technological infrastructure, low levels of digital

literacy among grassroots communities, and limited affirmative policy support targeting vulnerable groups (Mubah et al., 2017; Sukari & Nurachman, 2024). Therefore, strategies to strengthen innovative ecosystems must not focus solely on the provision of physical assets such as internet networks and digital platforms but must also include human capital development through technology-based education, digital entrepreneurship training, and policy incentives that favor micro and small enterprises. A concrete example can be seen in the city of Makassar, where the Warung Digital program aims to bridge these gaps by providing digital training to micro-entrepreneurs at the neighborhood level so they can leverage online platforms for promotion and transactions (Ayu, 2025; Makassar, 2024; Rini Nur et al., 2025). This approach illustrates the importance of integrating infrastructure development with community empowerment to ensure digital transformation occurs inclusively and equitably. Ignoring these aspects risks creating new layers of marginalization within the digital economy, even in cities that brand themselves as innovative. In developing countries, city repositioning must be accompanied by a strong commitment to democratize access to and competence in technology, so that all citizens can equitably participate in the innovation era.

The dynamics of technology-based entrepreneurship in urban areas heavily depend on the effectiveness of intermediary actors such as universities, business incubators, and digital communities, which function as strategic connectors in transforming innovative ideas into tangible solutions with economic and social value. The Innovation Intermediaries theory described by (Howells, 2006) explains that these actors play a vital role in facilitating technology transfer, forming business partnerships, and accelerating innovation commercialization by bridging gaps between knowledge, policy, and market needs. In Indonesia, earlier studies have shown that collaboration among Gadjah Mada University, the Yogyakarta Special Region Government, and local startup communities has led to the creation of civic tech projects like Jogja Smart Province, which integrates technology to address traffic congestion, improve public information access, and enhance government service transparency (Alam, 2023; Miroji, 2020). These initiatives demonstrate how higher education institutions, as knowledge production centers, can act as active catalysts within the city's innovation ecosystem by integrating academic expertise, government support, and community entrepreneurial spirit. The success of such models highlights that technology entrepreneurship development cannot thrive without strategic involvement from intermediaries capable of orchestrating diverse resources and reinforcing collective innovation capacity. Therefore, strengthening the position and function of intermediaries is essential in building technologically smart, inclusive, and knowledge-driven cities capable of addressing urban challenges through innovation.

Thus, building a city as an innovative ecosystem must be understood as a multidimensional process—one that does not rely solely on the availability of digital infrastructure but also demands tight integration with technological entrepreneurial dynamics and inclusive collaborative governance in order to produce sustainable structural transformation. The experiences of cities like Tallinn with its startup ecosystem, Jakarta through platforms like Qlue and digital *musrenbang*, Surabaya with its Command Center and public dashboards, and Bandung with its Techno Park show that the success of city repositioning depends on the ability to synergize actors such as government, private sector, academia, and communities within a mutually reinforcing system. Success is measured not only by the extent of service digitalization but also by how access to resources, economic opportunities, and social participation is equitably distributed among all citizens, including marginalized groups. This process demands the formulation of technocratic and deliberative policies grounded in empirical data, collaborative governance theory, and a strong understanding of local context. A systemic approach is required so that urban policies are not sectoral or fragmented but instead integrate social, technological, economic, and institutional dimensions within a development framework that is adaptive to disruption and responsive to change. Repositioning the city as an innovative ecosystem must not be reduced to a digitalization project alone—it must be a comprehensive effort to build a city that is intelligent, participatory, and competitive in meeting the global challenges of the 21st century.

## 5. CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

This study concludes that the repositioning of cities as innovative ecosystems is a transformational strategy that requires the integration of digital infrastructure and technology-based entrepreneurship within a mutually reinforcing system. Digital infrastructure provides the technological foundation for efficient, participatory, and responsive governance, while technology entrepreneurship serves as the driving force behind innovation and the creation of digital solution-based economic value. This literature review reveals that cities successfully combining these two elements—such as Tallinn, Bandung, and Jakarta—are able to produce

urban ecosystems that are adaptive to global disruptions, inclusive of small-scale economic actors, and collaborative in cross-sectoral decision-making processes. However, the success of this repositioning is strongly influenced by factors such as progressive public policies, human resource capacity, the presence of intermediary actors, and equitable access to technology and digital markets.

The findings of this research carry strategic implications for policymakers, academics, and technology entrepreneurs in urban areas. For municipal governments, this repositioning demands a governance reform toward a smart governance model that relies on service digitalization and fosters multi-actor collaboration in data-driven and innovation-based policymaking. For educational and research institutions, strengthening their roles as incubators of ideas, facilitators of technology transfer, and accelerators of innovation is essential to expedite the emergence of contextual digital solutions. For businesses and startups, the results underscore the importance of building collaborative networks, understanding technological regulations, and addressing urban challenges as entrepreneurial opportunities. Overall, this research offers a conceptual foundation that can be used to design sustainable strategies for developing economically, socially, and ecologically resilient innovative cities.

This study recommends that Indonesian cities aspiring to become innovative ecosystems should treat digital transformation and the strengthening of technology entrepreneurship as an integrated urban development agenda. Local governments should formulate policies that promote digital inclusion both spatially and socially, such as community-based digital literacy programs, expanded internet access in marginalized areas, and incentives for startups addressing urban social issues. Additionally, sustained collaboration between academia, government, and the private sector should be supported through adaptive regulations, the provision of collaborative spaces, and innovation funding schemes. On the other hand, a data-driven approach must be adopted in designing policy interventions to ensure their effectiveness and tangible impact on the quality of urban life.

This research has several limitations that must be acknowledged. First, as a literature review, this study does not include primary field data, so the findings remain conceptual and are dependent on the quality and diversity of the references used. Second, due to time and access constraints, only 33 articles from the 2000–2025 period were analyzed in depth, meaning that other important literature may have been excluded. Third, the study's scope remains macro in nature and has not specifically explored the unique conditions of small or medium-sized cities, which may differ significantly from metropolitan contexts. Therefore, further research is needed – empirical and comparative in nature, across various geographical contexts, and involving the perspectives of local actors – to strengthen the generalizability and validity of the conceptual framework developed in this study.

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