

Jin Chen

# Innovation Ecosystem for Green Smart City Building in China

**Abstract** Green Smart City (GSC), is one of the new types of cities which integrates eco-concepts and information technologies. As GSC construction is a resource intensive process, it requires a large amount of knowledge, information, talent and capital. Thus, setting up an innovation ecosystem is an astute way to promote the construction of a GSC. This paper, based on the case study by the Insigma Group, tries to explore the rules of innovation ecosystem building for the construction of GSCs in China.

**Keywords:** green smart city, resource, innovation ecosystem building

It has been demonstrated for quite some time both in domestic and foreign case studies that socio-economic development transforms two main characteristics over time; namely urbanization and city modernization construction. Cities are emblematic of advanced social productivities, and concentrate the latest scientific and technological achievements made by mankind. It is foreseeable that over the coming one to two decades, China will undergo profound social changes. These changes are continuously being accelerated by the urbanization process whose level is also constantly increasing. In addition, this new urbanization construction has been the driving force in promoting China's economic development.

Green Smart City (GSC) is a new-type of modern city characterized by efficient ecological management, developed IT infrastructure, and a prosperous economy along with harmony and stability (Chen, 2009). Constructing a GSC, involves innovating the construction model by applying and developing appropriate advanced technology, by changing the pattern of production and consumption and the method of decision-making and management, and by drawing upon the intra-city/intercity resources and potentialities by using technologies (such as IT, material

and energy) and the theories of humanistic and social science.

The attributes of a GSC feature the framework of a brand-new blueprint for a modern city. Not only are they two contemporary symbols of cities in the 21st century, but also they represent an emerging challenge to China's engineering technology and management. The construction of a GSC costs far more than vast resources and capabilities, including a large pool of talent, money and knowledge, and enterprises cannot survive and cope with these challenges alone. Therefore, it is of vital importance that the enterprise should develop an innovation ecosystem to integrate domestic and foreign resources and capabilities for a synergic effect (Chen, 2009).

The Insigma Group, backed by Zhejiang University, has developed a good university-industry cooperation model which is oriented by national strategy. Since the introduction of this new model at the 2008 launch of the Strategy of Green Smart City and its implementation, this has led Insigma to build a higher-efficiency university-industry cooperation system called an "Open Innovation Ecosystem." The key points that Insigma constructs a GSC based on innovation ecosystem are as follows.

## 1 Innovation in strategy: prioritizing GSC

As illustrated in *Figure 1*, a GSC is an integrated multi-layered innovation strategy which targets internationalization, high technology integration and large customers, and deals with industrial sectors, core technology, core capabilities and business patterns.

a. Basing it on six major industries, i.e., rail transport, energy & environment, smart city, smart business, smart life, and smart industrial park, and focusing on innovation;

b. Taking university-industry as the core, and starting from the key problem of productization and engineering around business demand, expediting interdisciplinary research on five frontier technologies, which are the Internet, software, control, sensor and power electronics, so as to enable a virtuous cycle between technology/product breakthrough and business innovation;

c. Basing it on the collaboration of innovation capability,

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Jin Chen  
School of Economics and Management, Tsinghua University, Beijing  
100084, China  
Email: chenjin@sem.tsinghua.edu.cn

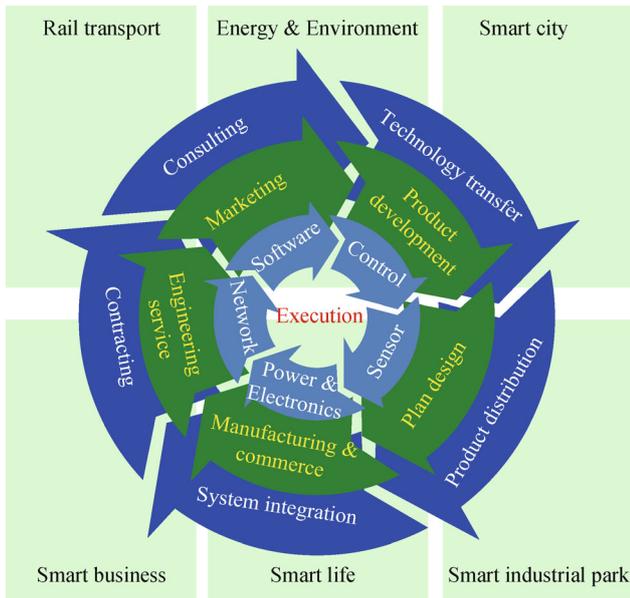


Figure 1. GSC strategy system of Insigma.

and depending on five core capabilities, namely marketing, product R&D, systemic scheme design, manufacturing & business procurement and engineering service so as to encourage collaborative innovation with strategic partners;

d. Upholding the idea of “Sharing Innovative Values,” and developing five main businesses including technology transfer, product distribution, system integration, contracting and consulting service, in the pursuit of an innovation-based win-win situation between Insigma and its strategic partners.

The multifaceted Green Smart City Innovation Strategy addresses key concerns with the innovation growth of Insigma effectively, and drives Insigma to concentrate more on accumulating core technological, enhancing capabilities, and on designing a business pattern for obtaining innovative values in its business operations.

## 2 Innovation in system: an open innovation ecosystem network

Guided by the multi-layered innovation strategy of GSC and oriented towards the technical, operational and capability demands for innovative development, Insigma further extends its existing university-industry collaboration network, and introduces capital as a factor into it. In addition, it constructs an open innovation ecosystem network which is made up of an internal research institute, a university-industry collaboration innovation system and an investment & financing system (Chen, 2015). The scenario is outlined in the following *Figure 2*.

The Insigma internal research institute system has a three-layered structure. The top layer is made up of the

innovation research institute which is affiliated to Insigma directly. As a unit to design and plan the price of the top layer of Insigma’s open innovation ecosystem, it relies on a state-level corporate technology center. It is also responsible for constructing strategic frameworks, mechanisms, procedures and training programs for innovative planning and collaboration. Furthermore, a subordinate wing, called the Supporting Service Section, is responsible for the overall planning of the investment support system along with the innovation and entrepreneurship decision system. The middle layer consists of three industrial group technology centers: namely the Insigma Science & Technology Research Institute, the United Machine & Electrics Research Institute and the Insigma Green City Development Research Institute. Finally, the bottom layer comprises a range of professional R&D centers, such as the Rail Transport Technology Center, the Energy & Environmental Technology Center among others, which are responsible for executing particular R&D projects.

The university-industry collaboration innovation system of Insigma comprises primarily three types of partners: the enterprise, the university and the research institute. In addition to existing partners in the three sectors, Insigma has also established a special sector for university-industry collaboration under the innovation research institute to proactively seek external collaboration resources both at home and abroad.

In Insigma’s innovation investment & financing system, the financial service division as the department in charge under the innovation research institute, establishes the partnership with asset management companies, VC organizations and PE funds. Not only does this collaboration help to provide financing support for internal industrial incubation, but also it promotes technology transfer and external industrial incubation through the joint-venture.

On the whole, Insigma follows the idea of “One Core, Two Platforms and Three Layers” to develop the innovation system. One Core: oriented by profitability and development, carrying out the interaction between technological innovation and service innovation, and international advanced and domestic leading core technologies with high reusability. Two Platforms: based on the technical strategy of “Fast Follower,” constructing the open collaboration innovation platforms for university-industry collaboration and international cooperation. Three Layers: the vertical integration of the innovation research institute, the industrial technology center and the professional R&D center, to ensure innovation resources flow rapidly and feedback efficiently.

## 3 Innovation in mechanism: systemic synergistic operating platform

The outstanding aspect of Insigma’s innovation mechanism

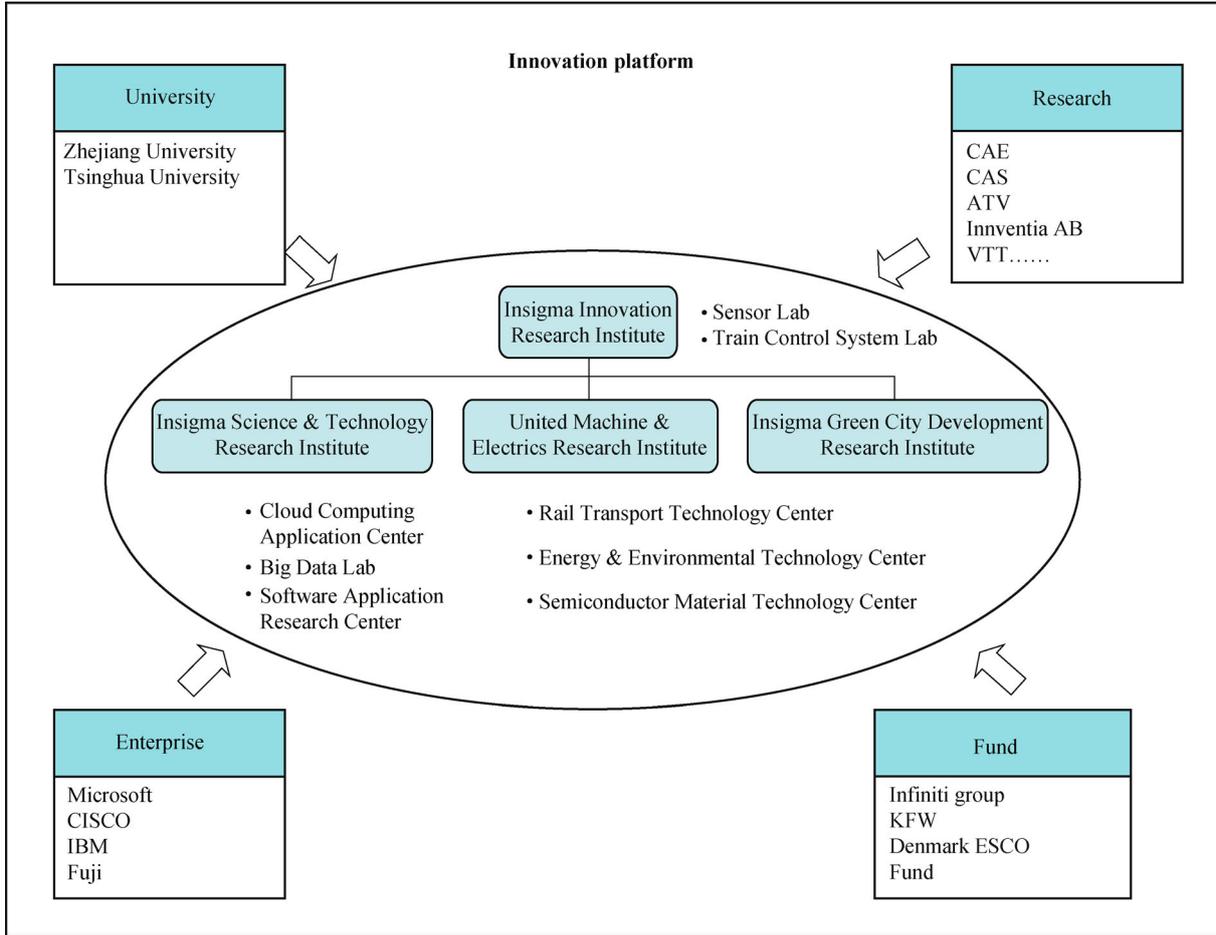


Figure 2. Open innovation ecosystem network of Insigma.

is the integration of innovation procedure with operational procedure, and the achievement of the rapid flow of innovation resources through building a systemic operational platform.

3.1 Complementary operating models: independent model + consolidated model

To form an operational system in which product technology, system solutions and project operation nest each other, Insigma’s synergistic operating platform adopts two complementary operational models: the independent and the consolidated (see Figure 3).

The independent model is described as follows: Insigma Sci-Tech, United Machine & Electrics and the Group-level entity (including Insigma Construction and Insigma innovation research institutes) focus on the cultivation of core capabilities, and develop businesses’ flexibly for specific industrial customers and international customers on the basis of subdivision demand analysis on Green Smart City. The first, Insigma Sci-Tech, focuses on the construction of a smart city by developing businesses such

as through-card service, digital city management, smart transport systems, environmental monitoring systems, digital television networks and industrial information system development amongst others. It is also devoted to providing the systemic solution of “Smart City” by an industry-level synergistic platform. The second, United Electrical & Mechanical concentrates on the construction of Green City, and develops businesses such as desulfurization, rail transport, city energy saving and water treatment. It also provides the systemic solution of Green City through an industry-level synergistic platform. Finally, according to the special requirements for Green Smart City, the Group-level entity is responsible for the construction of infrastructure, and provides financing service and innovation consulting services such as science park planning, science incubators, business invitation, national enterprise ownership reform and industry development planning. Furthermore, it endeavours to cultivate the operating mechanism and capabilities for the ‘Green Smart City’ program.

In the consolidated model, the Group-level entity, taking cities as the unit, undertakes a comprehensive construction

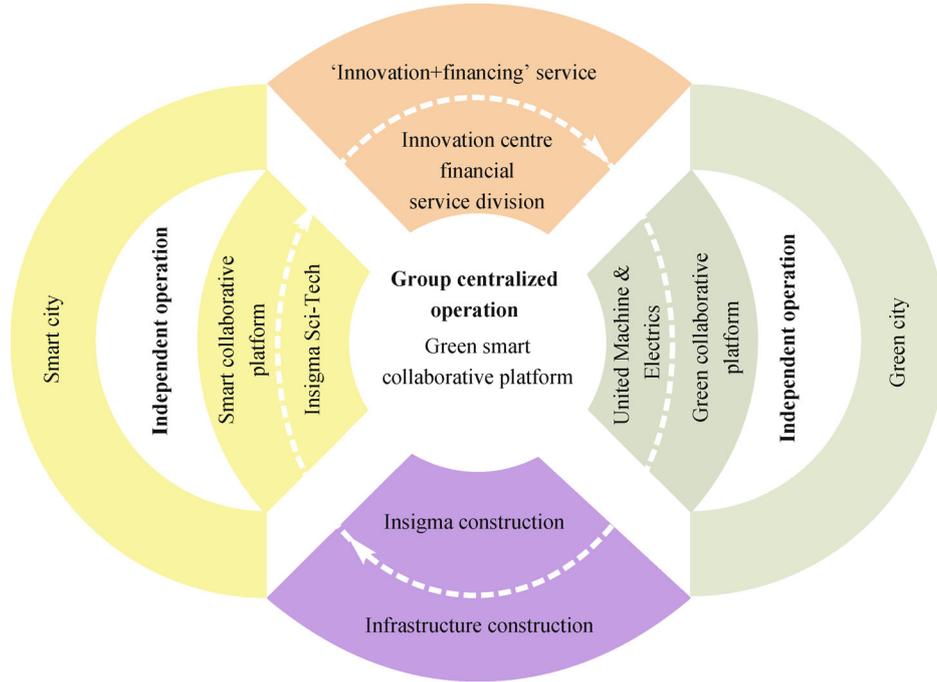


Figure 3. Business model of the Insigma’s synergistic operational platform.

scheme for Green Smart City. This is managed as projects and integrates the systemic solutions provided by Insigma Sci-Tech and United Machine & Electrics through the group’s synergistic platform (crowd-sourcing). Insigma Sci-Tech and United Machine & Electrics, starting from their respective strategic focuses, undertake Green and Smart systemic solutions, and integrate product technology plans of their subsidiaries through their respective synergistic platforms.

The independent model and the consolidated model are complementary, which can help Insigma not only to develop flexibility and mobility, but also develop synergistic effect.

### 3.2 Organization mechanism paying equal attention to capability development and collaborative innovation

Besides promoting the change of divisionalization, Insigma classifies internal entities into five categories of organizational units and links them up sequentially with six core processes to implement the sustained development of innovation (see Figure 4).

There are two key features of Insigma’s organization mechanism. First, by setting up a vertical departmental/institution, Insigma attaches importance to the development of its core capabilities so that each process of innovation is supported by capabilities delivered from

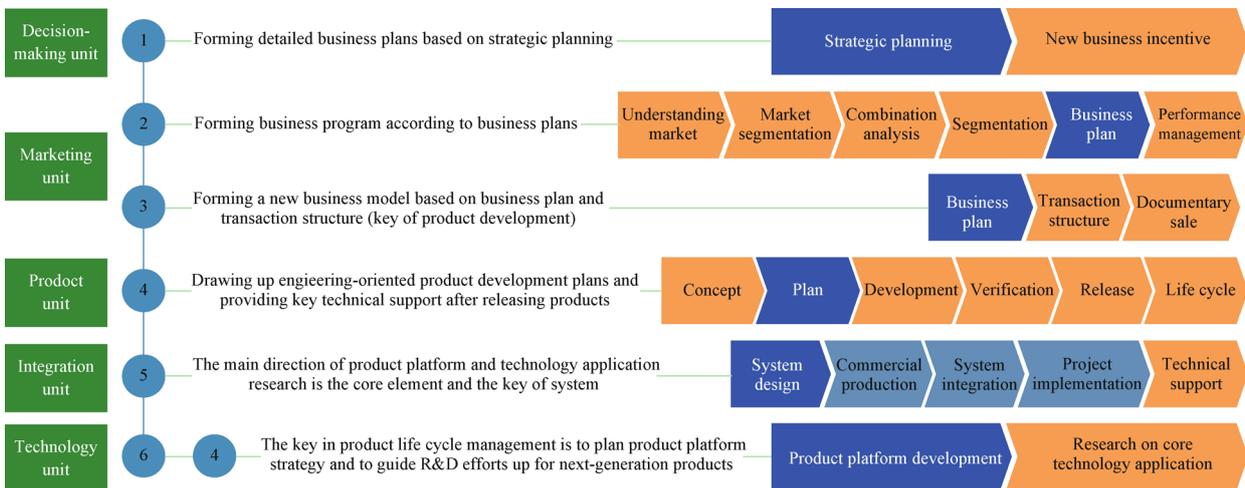


Figure 4. Organizational mechanism of Insigma’s innovation system.

matching institutions, teams or departments. Second, by designing horizontal procedures, Insigma pays attention to the high-efficiency execution of collaborative mechanisms so that many innovation capabilities and resources are integrated to promote the rapid scale development of industries.

As a whole, Insigma introduces six processes for innovation so that each step is implemented by a specific institution, department and team, forming an innovation value chain and a development path for its capabilities right throughout every process. At the same time, Insigma adopts the deliberation system in the key decision-making steps of each process, and calls for the stakeholders to participate in decision-making through sub-procedures. This not only carries forward the culture of interest sharing in innovation, but also it strengthens performance orientation and collaborative culture for executing innovation strategies. Interest sharing, performance orientation and collaboration stem from Insigma's corporate value, namely "originated from education, returned to society."

#### 4 Insigma's innovation progress

Benefiting from open corporate innovation ecosystems, based on the Strategy of "Green Smart City", Insigma has successfully accumulated and industrialized many key technologies in five core technology fields including the Internet, software, control, sensor and power electronics.

- Employing cloud computing and Internet security technologies to bring about information sharing. For example, with the help of advanced encryption algorithms (AEA), using distributed cloud computing & storage technology to integrate the essential applications in Internet in order to provide the most convenient, abundant, secure and responsive services to all levels of users.

- Employing technologies such as big data, industrial design and graphic/image processing to strengthen production advantages in operating systems, databases, application programs and multimedia. For example, the big data technologies based on distributed programming framework, NoSQL database, in-memory database data, and data compression, mining and retrieval, have promoted the development of business on IT services and system design in Insigma.

- Implementing the innovation of the Internet of Things (IOT) business by using technologies such as smart sensors, wireless sensor networks and embedded systems. For example, some smart IOT devices, such as SN6500 and SA735, which integrate several sensor technologies, have passed the online test for high-speed trains. This has contributed to the industrialization of sensor technology.

- Adopting the technologies such as industrial automation, control equipment as well as device, control system application to enable information acquisition and control operation for control objectives. Examples include the

upgraded desulfurization/denitrification technology which boosts efficiency significantly.

- Applying device technology, system control technology and application technology in the power electronics field to improve the accuracy and efficiency of electrical energy conversion and control. For example, the breakthrough of IGBT has supported product innovation in the semiconductor business effectively.

In addition, the implement of open innovation ecosystems program has both improved the innovation level and operational performance of Insigma significantly, and also brought about a tremendous social innovation effect.

First, Insigma's open innovation ecosystem has greatly promoted the development of internal innovation platforms. Insigma, as a state-level technology center of corporation, a national research center for engineering technology and a innovation pilot enterprise, has undertaken several key subjects allocated by the Ministry of Science and Technology (MOST), the National Development and Reform Commission (NDRC) and the Ministry of Industry and Information Technology (MIIT). In the past five years, nearly CNY  $80 \times 10^6$  of scientific research funds has been earmarked for Insigma. In 2010, Insigma MIIT was honored with State-level Technology Center of Corporation, and was confirmed as the fourth batch of innovation pilot enterprises. Furthermore, it also collaborates with Zhejiang University to run the National Research Center for Smart Train Engineering Technology. In 2013, Insigma was given the title of State-level Exemplary Base for International Science & Technology Cooperation due to its extensive effects in international cooperation.

Second, Insigma's open innovation ecosystem has greatly impacted the development of cooperation innovation platforms. In 2010, Insigma and BBR (a German enterprise) contracted the international sci-tech cooperation project concerning the core technology of computer safety, which are applicable to train control systems in rail transportation. Another international cooperation project, IFN Signaling, concerns  $24 \times 10^6$  eurs financed jointly by Insigma, BBR and two other European companies (KTC and TECSYS). In 2011, Insigma cooperated with IBM and Zhejiang University to build the Cooperative R&D Center for Green Smart City. In the same year, Insigma and Cisco set up City Cloud, a joint-venture specialized in developing the smart city cloud system based on the technologies of cloud computing and smart city.

Finally, Insigma's open innovation ecosystem has effectively propelled international technology transfer and regional innovation development. These effects are shown as the following two aspects. On the one hand, the strategic collaboration of the international innovation research institute set up by Insigma with domestic research institutes (e.g., Zhejiang University), international research institutes (e.g., ATV) and international startup technology companies (e.g., Finland-based CLEEN), and the model to cooperate and build regional industrial technology institute together,

pushed technology transfer and incubation and developing new industries. On the other hand, Insigma has pushed to offer park creativity services and new city construction services. It has also established the industrial aggregation, by upgrading and innovating platforms for some parks or cities with the support of technological resource networks of international innovation research institutes. This in turn boosts local innovation and industrial development.

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