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Construction of Interdisciplinary Teaching System for Urban Safety and Emergency Management of Higher Education

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Abstract

From the perspective and subject division or classification system of higher education of China, urban science and urban management is categorized under the discipline of Management Science and Engineering or Public Business Management in China's higher education teaching and research system, graduates majoring in urban science and especially urban management are generally awarded a bachelor's degree in management. However, from the perspective of actual work, urban management must be supported by corresponding engineering technologies, information technologies, etc., and it cannot be solely handled by management discipline knowledge. City encompasses a broad and complex system that integrates physical, human, and administrative components, representing a convergence of natural sciences, social sciences, management sciences, and technological sciences. Based on a comprehensive analysis of the systemic characteristics of cities, this paper explores the multidimensional nature of urban supervision and emergency management. This paper adopts a multi-technology and multi-scenario approach to reverse-engineer professional development requirements in line with the demands of modern urban governance of China. This paper establishes a multi-level educational objective system for urban science and its applied branches, introduces the concept of resilience maintenance tailored to urban science and management teaching framework.

Keywords

Systems Engineering; Urban Science; Urban Management; Interdisciplinary Studies; Discipline Development.

1. Introduction

Cities, as the most densely populated and industrially concentrated areas, naturally become the central focus of emergency management in China. From the perspective of national development trends, urbanization is not only an inevitable path to modernization but also a key

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indicator of progress and a strong driver of coordinated regional development. Urban agglomerations represent the primary form of new urbanization.Over the past four decades, China has made remarkable progress in new urbanization. The spatial structure of urban agglomerations has become more defined, and the strategic layout of modern urbanization has largely taken shape. On one hand, with the rapid evolution of cities, metropolitan areas, and urban agglomerations in terms of spatial form and physical infrastructure, concepts such as safe cities, resilient cities, smart cities, healthy cities, and livable cities have gained traction in urban science, planning, and design. These concepts have been applied in urban management practices, including planning, design, construction, operation, and emergency response.

In response to these new situations, tasks, and requirements, higher education institutions in China are actively exploring undergraduate cultivation models, educational methods, and teaching systems that align with the future development and governance needs of cities, metropolitan areas, and urban agglomerations. In the context of emergency management, the primary objective is to safeguard people's lives and property. No matter how the country and society evolve and change, the most fundamental function of a city is to provide living and production conditions. The research goals of urban science and urban management-related disciplines are to make cities safer and more efficient. The goal of professional higher education is to cultivate engineers and technicians who can undertake the efficient management of cities. Correspondingly, the curriculum design for urban science and urban management should be solely based on these goals.

Curriculum system is the basis and core of professional construction and personnel training. In particular, the cultivation of students' abilities should be closely centered around specific professional courses. In universities, professional education and teaching are based on and centered around courses. In the curriculum design of various majors, the traditional boundaries and scopes of the majors are relatively clear, and the concepts and processes of course design are relatively clear. In recent years, with the emergence of various new majors, the trend of cross-fusion between different majors has become increasingly obvious, the depth of the fusion has been deepening, and the breadth of the fusion has been gradually expanding, gradually blurring the boundaries of the original traditional majors [1, 2]. In addition to the cross-fusion between different disciplines and specialties, the changes within disciplines and specialties themselves are also quite evident. One of the most notable features is the sustainability of disciplines and specialties [3-5]. Unlike traditional science and engineering majors, emergency management, especially urban management, is a highly practical discipline. Given the diversity of urban science and the objects of urban management, in the design of professional courses, scholars first propose to utilize the concept of sustainable development to design the course system, taking into account the dynamics, complexity and variability of the city [6-8]. In Chinese university education, the most important aspect is the issue of employment for graduates after graduation. Therefore, in the course design, setting the goal of employment as the main orientation has become a key aspect of the course design [9]. In recent years, the concept of resilient cities that has gained popularity in China has also profoundly influenced the curriculum design of urban management, urban emergency management and other related fields. Resilient cities represent the management objects that graduates in urban management and emergency management fields need to deal with in their employment and work. Incorporating the understanding of resilient cities into the curriculum system is also an expression of adapting to social development [10-12]. Specifically when it comes to the objects of urban management, scenarios such as rail transit, communities, public transportation, and building safety are very typical. Some universities, in their design of professional courses, not only reflect and highlight the course teaching contents of these scenarios, but also introduce some efficient teaching methods to enhance the teaching effect of the courses [13-15].

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However, the development of urban management as a major has sparked debates, mainly regarding its alignment with the responsibilities of the Ministry of Emergency Management of China and the definition of its educational objectives and target audience. These debates affect classroom instruction and student recruitment, particularly regarding whether the major should focus on infrastructure or broader development, and whether faculty should be recruited from public administration or other management-related fields.

From the Central Urban Work Conference of China in July 2025 and the series of documents and requirements issued by the central authorities recently, cities will undoubtedly be the most important new direction in the future, in addition to natural disasters and specific industrial sectors that have their own main responsibilities and duties in emergency management. Therefore, urban management should mainly focus on urban safety and emergency management, smart cities and resilient cities, and should have the main training goals of system science, large-scale urban collaborative safety control, urban transportation, and municipal infrastructure risks. Correspondingly, the introduction of urban management professionals should also be carried out around these goals.

In line with the requirements of building a high-level, distinctive emergency management system, this paper applies systems engineering, resilience maintenance, and dialectical contradiction analysis to address key issues in urban management major development: how to build it, how to build it well, and how to sustain its vitality. Based on this, the system structure and suggestions of urban management professional construction are put forward.

2. Situation and Difficult Problem of Urban Management Major

2.1. Societal Expectations for Urban Management

In China's National Work Safety Plan, the urban domain clearly proposes goals such as "accelerating the cultivation of professional undergraduates" and implementing safety education and training programs, aiming to build a strong safety risk prevention and control system and support the sustainable development of work safety.

Specifically, in terms of optimizing urban safety layouts and promoting the deep integration of work safety into the construction of, smart cities, and urban renewal, the plan emphasizes the need to effectively align urban planning with territorial spatial planning. It calls for the creation of an urban spatial safety development pattern capable of preventing and controlling major security risks.

With the acceleration of urbanization, urban populations, functions, and scales continue to expand. Development models, industrial structures, and regional layouts are undergoing profound changes. The widespread use of new materials, new energy, and new technologies, as well as the emergence of new industries, new business forms, and new fields, have made urban operational systems increasingly complex.

Based on the viewpoint presented earlier in this article, that higher education should have employment and work as an extremely important goal, the professional settings and courses offered in China's higher education clearly reflect the development trends of the country and society. The settings in universities and higher education also have typical characteristics of the times. Correspondingly, the development of higher education in China—including urban science and urban management majors—exhibits distinct era-specific characteristics. In recent years, as a series of urban agglomeration development strategies proposed by the Chinese national government have been gradually implemented, professional construction has progressed rapidly and intensively. Unlike the administrative responsibilities of the urban management municipal administrative departments of China, the technical and theoretical foundations of urban management are broad, complex, and multidisciplinary, involving long professional chains and numerous specialized fields.

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Accordingly, the curriculum design and teaching arrangements for urban safety, urban management, and emergency management should fully reflect interdisciplinary integration, scenario-based learning, and systems thinking.

2.2. Constraint and Dilemmas of Urban Science and Management Major

(1) Lack of Reference Models for Major Development

There is no established model for developing urban science and related safety management majors. Key questions remain:

What should urban management govern, manage, and serve?

How should undergraduate cultivation objectives be defined?

Under the current college entrance examination system, how should enrollment be planned?

What should be taught, and what are the career prospects for graduates?

These are practical challenges that major developers must address.

(2) Mismatch Between Curriculum Design and Societal Needs

In practice, urban management, urban safety control, and emergency management increasingly demand specialization and collaboration. Students are expected to possess not only traditional science and engineering backgrounds, but also broad perspectives in spatial science, systems science, and complex systems.

However, current curriculum design in many universities is often based on existing faculty expertise and traditional disciplinary advantages, leading to significant variations in course offerings across institutions. Most foundational courses remain rooted in traditional disciplines such as public administration, political science, and sociology.

This creates a substantial gap between the standardization, adaptability, and social relevance of professional construction and the actual needs of urban governance.

(3) Ambiguity in Governance Responsibilities

Furthermore, there is another particularly important constraint or predicament, which is the current system of ownership and management of higher education institutions in China. In China, higher education institutions can be classified as either public or private. Public institutions include national universities, local universities, and university-affiliated with various ministries or commissions directly under the Ministry of Education of China. The first category consists of national universities directly under the Ministry of Education of China, which are generally comprehensive universities. The second category includes universities managed by local governments, such as industrial universities, agricultural universities, normal universities, etc., which vary significantly. The third category consists of universities affiliated to government departments, with extremely distinct industry characteristics. Generally, these universities place great emphasis on the establishment of specialized programs related to the responsibilities of the government departments, aiming to cultivate professionals in their respective industries. Other types of programs are rarely offered.

Under China's current administrative system, the Ministry of Emergency Management shares responsibility for urban safety and emergency management with other departments. This joint governance model has resulted in the urban domain not being fully integrated into a unified government management system. As mentioned earlier, under the current administrative system of the State Council and its subordinate departments in China, the Ministry of Emergency Management, along with other constituent departments of the State Council, including the Ministry of Housing and Urban-Rural Development, the Ministry of Public Security, etc., jointly bear the responsibility for urban safety and emergency management. This joint governance model has led to the fact that the urban sector has not fully integrated into a unified and clear government management system. This is also an important reason why China has made progress in natural disasters, industrial accidents, and transportation emergency

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management, but urban safety and emergency response still lag behind. When disasters and accidents are relatively easy to handle and have obvious achievements, various departments rush in en masse. However, when the disasters are larger and require significant accountability and a considerable amount of time and effort, departments disperse en masse. This has become a common phenomenon frequently encountered by China when facing safety prevention and emergency management, and behind this manifestation lie underlying issues such as unclear management responsibilities, unclear primary responsibilities, and subjective arbitrariness in the distinction between interests and responsibilities, which are fundamental problems.

Urban security prevention and emergency management are important manifestations of the modernization of national governance capabilities in the future. This is a responsibility and historical mission that the Ministry of Emergency Management of China must undertake. Although the current focus remains on extending safety controls from natural disasters and industrial incidents into urban areas, these guidelines are clearly significant for clarifying the responsibilities of safety supervision over new business forms and emerging risks.

3. Analysis of Urban Systematic Characteristics and Management Connotation

3.1. Surface Features and Complex Connotations of Cities and Agglomerations

Cities, metropolitan areas, and urban agglomerations represent a hierarchical spatial scale of urban development. Academically, a city is defined as a spatial concentration point of population and industry. A metropolitan area refers to a spatial form of urbanization centered around a mega or large city, with strong radiative and driving functions, and a one-hour commuting radius as its basic scope. An urban agglomeration consists of multiple interconnected metropolitan areas, linked by major transportation arteries, and reflects the core functional positioning of cities within a broader system.

From an economic perspective, the purpose of urban formation is to achieve agglomeration and intensive effects. From the viewpoint of system composition, a city or urban agglomeration system—comprising basic support networks such as modern transportation and information systems—can be divided into:

(1) Quasi-static physical networks (e.g., infrastructure);

(2) Environmental networks (e.g., ecological and natural systems);

(3) Dynamic logistics and population flow networks;

(4) Information flow networks.

From the interaction between humans and the natural/ecological environment and between humans and the social environment, cities and urban agglomerations are typical complex giant systems that integrate physical, human, and social activities. The agglomeration, diffusion, radiation, and collaboration of cities are manifestations of system-level interactions among subsystems at micro, meso, and macro levels. These interactions involve the bearing layer, activity layer, strategic layer, and the network flows attached to them. The most visible example is the transportation network connecting various regions within an urban agglomeration.

3.2. The Systematic Nature Of Urban Management

Cities and urban agglomerations, as regions with the highest intensity of resource development, the most frequent social activities, and the greatest diversity of functions, are central to national modernization governance. They serve as the primary platforms for implementing national strategies such as urban agglomeration development, natural resource management, and emergency governance.

Cities are among the most complex systems in human society. They are characterized by:

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(1) The densest population;
(2) The richest diversity of life;
(3) The most complex industrial structures;
(4) The most intricate relationships;
(5) The most dynamic evolution;
(6) The greatest unpredictability.

These features make urban management—whether in normal conditions, disaster prevention, or emergency response—extremely complex, requiring consideration of numerous factors and constraints.

The coordinated development of cities and urban agglomerations, and the realization of high-level socialist modern cities, essentially depend on how regional resources can be integrated and function at a higher level.

In recent years, major urban events in China have shown increasingly comprehensive and multi-dimensional characteristics. However, the safety foundations of some cities remain weak, and their safety management capabilities are not yet adapted to the requirements of modern urban development. In some cities—and even large metropolitan areas—major production safety accidents have occurred frequently, causing heavy losses to people's lives and property, and exposing many loopholes and shortcomings in urban safety management.

Regardless of changes in environmental conditions or development planning, ensuring the safety of large populations and the normal functioning of cities remains the core mission of urban safety and emergency management education and practice. This reflects the strategic goal of people-centered new urbanization.

Improving the comprehensive level of urban safety prevention and control—especially in large cities—is not only a challenge for China's modernization governance but also a major topic in the development of urban safety technology and emergency management disciplines.

4. Strategy for Urban Science and Management Major Construction

4.1. Design of Professional Development System Objectives

From the perspective of actual societal needs, the core mission of higher education lies in undergraduate cultivation, which can be categorized into three levels of ability:

Basic survival skills – the ability to support oneself;

Adaptive capacity – the ability to respond to changes in work and society;

Continuous improvement–the ability and motivation to keep learning and contributing to society.

From the fundamental purpose of education, the formulation of educational policies and the allocation of teaching resources are technological means aimed at achieving harmonious coexistence among individuals, society, and the environment through education.

In designing the development objectives of the urban management major, Outcomes-Based Education (OBE) can be refined into the following key questions:

Do students possess basic survival and employability skills?

Can they adapt effectively to job requirements and societal changes?

Do they have the ability and motivation to continue learning and serving society?

These questions should guide the objective-setting of urban management major development.

From the perspective of the actual situation and needs, the core of higher education lies in the cultivation of people, among which there are also levels, which can be basically divided into three kinds of abilities: the cultivation of students' self-survival ability, the ability to adapt to

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changes and the ability to continuously improve. From the perspective of the fundamental purpose of education, the formulation of educational policies and the allocation of teaching resources all belong to technological means, whose fundamental goal is to realize the symbiosis and win-win situation and long-term coexistence between people, people and society, and people and the environment through education to the maximum extent. In the design of urban management major construction objectives, Outcomes based education can be refined into whether students have basic survival and working abilities, whether they have the ability to adapt well to work needs and social environment changes, and whether they have the ability and motivation to continue to improve their own learning and serve the society.

4.2. Resilience and Sustainable Development for Urban Management Major

The development of a higher education major is a systematic project. Its subsystems and components—such as the curriculum system, faculty, teaching methods, practical training, and employment support—are interconnected and mutually reinforcing. Together, they form a stable and resilient organic whole.

If there is disconnection or imbalance among these elements, the overall effectiveness of major development will be significantly diminished, leading to negative consequences in recruitment, teaching, moral education, practical training, and employment.

To achieve the intended goals of major development and ensure sustainable and positive growth, it is necessary to apply systems engineering thinking in the design process. While system stability and resilience generally decrease with increasing scale and complexity, ecosystems tend to become more resilient due to diversity, interdependence, and self-regulation.

Drawing from the ecosystem mechanism of maintaining stability and resilience, the following principles should guide the sustainable development of the urban management major:

Analyze the internal and external environment of major development; Integrate existing educational resources and development objectives, highlight core features, and address the main contradictions in undergraduate cultivation; Selectively integrate related disciplines to achieve complementary strengths and interdisciplinary synergy.

5. Core Areas in Urban Management Major Construction

5.1. Analysis of Professional Domain Construction in Urban Management

(1) Skill Module Design Oriented Towards Employment and Career Needs

Corresponding to the broad urban management technology framework, and considering the existing educational resources and development objectives of the university, this paper proposes a four-core competency module structure for the urban management major: Engineering Management: focuses on cultivating technical capabilities related to the urban physical environment, infrastructure characteristics, and construction safety.

Information Management: serves as the foundation for system cognition and understanding, supporting data analysis, information modeling, and smart city development.

Safety Management: guided by system safety theory, it applies systems engineering methods to analyze urban safety systems, build risk maps, and develop modular and flexible practical training systems.

Emergency Management: focuses on response and recovery, emphasizing scenario-based training and multi-agency coordination in urban emergencies.

These modules are deeply integrated to reflect the interdisciplinary nature of urban management: engineering add safety, emphasizes the principle of minimum cost for maintenance, maximum security resilience and stability in safety management during

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infrastructure development; engineering add emergency, integrates emergency thinking into the front-end design and process management of urban projects; engineering + information, enables real-time monitoring and visualization of urban physical, human, and dynamic data.

(2) Correlation and Consistency of Skill Module System

From the perspective of system science and system engineering, the general knowledge system can be divided into four components: identification and analysis, prediction, control and management, evaluation and feedback. In the field of urban safety, widely applied theoretical models include: the public safety triangle theory, urban safety system theory, and the concept and model of safe and resilient cities.

These models fall under the category of identification and primary-level knowledge. The design of management and control-related majors, as well as their capability training and practical teaching, are top-level applications. They can only be effectively implemented after foundational courses in identification, analysis, prediction, and design are completed. Safety management emphasizes prevention and preparedness, while emergency management focuses on response and recovery. From the perspective of daily urban governance, the scenarios for safety control and emergency response differ significantly, as do the management mechanisms, operational processes, and technical requirements of the curriculum content. These differences determine that urban management courses are interdisciplinary, multi-link, and goal-oriented. Based on the current educational models, curriculum systems, and teaching methods of related majors such as: emergency management, emergency technology and management, urban safety and urban rail transit.

This paper integrates the latest policy requirements and development practices in the urban domain. Using the hierarchical classification method of systems engineering knowledge, it designs a broad urban management technology framework and a corresponding capability-oriented curriculum system.

5.2. Analysis of Professional Construction in Urban Safety and Emergency Response

(1) Integration of Urban Safety and Emergency Features

Urban management should integrate and highlight the characteristics of safety and emergency response, and build a key knowledge system covering: basic consensus, professional knowledge, safety protection, emergency technology.

This system should span the entire urban life cycle, including planning, construction, operation, maintenance and emergency response, that is called PCOME system.

The goal is to establish a shared cognitive foundation among planners, builders, operators, and citizens, and to eliminate knowledge blind spots and barriers caused by: inertial thinking, professional silos, cognitive differences.

(2) Development Approach Centered on Safety and Emergency Response

Urban safety, engineering management, information management, and emergency management are all typical interdisciplinary fields. Professional development must emphasize both theoretical knowledge and practical capabilities, while integrating insights from industry, information technology, culture, and governance. This presents a significant challenge for major construction.

Urban safety incidents often result from causal chains triggered by natural disasters, planning flaws, or management failures. Therefore, it is crucial to build a systematic knowledge framework for urban safety risks that spans multiple links and multiple stakeholders.

In light of the new era development requirements and the goals of building safe, smart, and resilient cities, urban management professionals must master traditional risk prevention and control methods, and be equipped to handle multi-scenario urban emergencies, especially new

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types of compound disasters. It is foreseeable that uncertain factors affecting urban operations will increase sharply, especially in large-scale natural disasters or public health crises. In such scenarios, abnormal management and control measures will have a major impact on urban safety. This raises the bar for professionals' dispatching, command, and organizational capabilities, making targeted professional training more urgent than ever.

Guided by the big-city safety concept, this paper proposes a new-era urban safety education and training model. Based on traditional safety technology, it adopts a multi-disciplinary approach combining industry, information, culture, and governance to design a training model and teaching system specifically for urban safety practice. Key components include urban risk planning and assessment design, lifeline system operation management and risk monitoring and early warning, integrated pipeline engineering operation, maintenance, and management, public safety risk emergency rescue and command. this model is fully aligned with the practical needs of urban management, especially in the areas of safety control and emergency response.

On this basis, a corresponding teaching and practical training system should be developed, including:

Implementation of urban management education and training, focus on urban safety prevention and control and emergency response, Flexibly combine and expand the urban safety education and training system, summarize and refine the general requirements, rules, and practices of the whole-process, whole-chain urban safety and emergency system, use typical domestic and international cases for illustration.

Conceptual Framework for Urban Management Education and Training

Analyze the multi-link, multi-stakeholder needs of urban and urban agglomeration safety under the new situation, develop urban safety risk maps, explore risk management models suited to multi-scenario applications, build a risk identification graph system, establish a comprehensive knowledge system covering planning, design, operation, and emergency response, design a teaching and training system based on the big-city safety concept.

Practical training program for urban management education, focus on peacetime safety risk prevention and control, integrate interdisciplinary knowledge from industry, IT, culture, and governance, use mind mapping, ergonomics, and system dynamics to visually and structurally represent the urban management practical training system, construct impact identification analysis and safety prevention and control graphs for urban systems, develop actionable teaching plans.

Develop systems for: hidden danger investigation, risk assessment and judgment, emergency response in typical urban scenarios, information support systems, emphasize dispatching and command under emergency scenarios and the application of information systems.

6. Conclusions

Adopting the thinking mode of safety engineering to handle emergency event management results in the lowest cost and the highest benefit; while constructing the safety control and emergency response system with the thinking mode of emergency management leads to the highest cost and the lowest return. The specific job requirements in the field of urban safety and emergency management should be reflected in the university education of urban science and urban management programs, and this means that the characteristics of systems science and systems engineering should be particularly emphasized. This paper systematically examines the systemic characteristics of cities, metropolitan areas, and urban agglomerations, and on this basis, summarizes the connotation and functions of urban management in the new era. It also analyzes the current status and challenges of urban management as an academic discipline, particularly under the evolving societal and governance context. The main contributions of this study are as follows:

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(1) A Three-Tier Undergraduate Training Objective System

The paper proposes a competency-based framework for urban management education that includes: basic survival skills (employability and foundational knowledge), adaptive capacity (ability to respond to change and complexity), continuous improvement (lifelong learning and social contribution).

(2) Curriculum System Design Based on Urban Safety and Emergency Response

Taking urban safety and emergency response as a typical application domain, the paper designs a capability-building model and a multi-mapping curriculum system aligned with the broad urban management framework. This provides methodological support and practical guidance for the future development of the urban management major.

In summary, this study offers a systematic, interdisciplinary and application-oriented approach to the construction of urban management subject. It responds to the complex challenges of modern urban governance and contributes to the cultivation of professionals capable of managing safe, smart, and resilient cities in the new era.

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