

Human fingers differ in their length (Chinese proverb), while countries differ in their level. According to national level of income, development, and modernization, all countries in the world can be categorized into advanced and developing ones generally (Example 1.1). Studies on why advanced ones get advanced, how they maintain their level, and how developing ones enter into the advanced club are interdisciplinary and fall into the scope of the modernization science or modernizations. This chapter briefly introduces the definition and nature of the modernization science and its methodology in general sense.

Example 1.1 Grouping of Countries

Countries can be categorized in different ways and compared no matter how they are classified. The World Bank divided countries into three groups according to the national income per capita, namely, high-income, middle-income, and low-income countries (World Bank 2008); the United Nations Development Program (UNDP) categorizes countries into three groups with high, middle, and low human development indexes, respectively (UNDP 2009); the United Nations Statistics Division classifies countries into more-developed and less-developed countries, or developed and developing countries, for the statistical purpose (UN 2008). *China Modernization Report* divided countries into advanced and developing countries based on their second modernization indexes. Developing countries are further divided into moderately developed, preliminarily developed, and underdeveloped ones (RGCMS 2008). Advanced countries are not advanced in all aspects, and developing counties may take the lead in some fields.

(continued)

Classification of countries in 2005							
World Bank		UNDP		United Nations Statistics Division		China Modernization Report	
Category	Number	Category	Number	Category	Number	Category	Number
High income	57	High human development	73	More developed	56	Advanced countries	20
		<i>Very high</i>	31				
Middle income	97	<i>General high</i>	42	Less developed	173	Developing countries	111
<i>Upper middle</i>	40	Medium human development	76	<i>Other less developed</i>	123	<i>Moderately developed</i>	25
<i>Lower middle</i>	57					<i>Preliminarily developed</i>	39
Low income	56	Low human development	21	<i>Least developed</i>	50	<i>Underdeveloped</i>	47
Total	210	Total	170	Total	229	Total	131
<p><i>Note:</i> (1) Grouping samples from the World Bank, UNDP, and United Nations Statistics Division, including qualified countries and regions; (2) according to the classification of the World Bank, middle-income and low-income countries are all developing countries; (3) UNDP considers 31 countries or regions with very high human development are advanced ones and another 149 countries (or regions) are developing ones; (4) according to the United Nations Statistics Division, developed countries (more-developed countries) include European countries, North American countries, Australia, New Zealand, and Japan, and others are developing countries (less-developed countries) including 50 least-developed countries and other developing ones; (5) in <i>China Modernization Report</i>, the 131 sample countries have a population of over one million in 2000 and with complete data; the average value of high-income countries' second modernization index is 100; the second modernization index of an advanced country should be higher than or equal to 80 and that of a developing country should be lower than 80; among developing countries, moderately developed countries have their indexes lower than 80 but higher than the world average; preliminarily developed countries have their indexes lower than the world average but higher than that of underdeveloped countries whose indexes should be less than 30 (or 60% of the world average)</p> <p><i>Source:</i> World Bank (2008), UNDP (2009), UN (2008), RGCMS (2008), He (2010a)</p>							

1.1 Definition of Modernization Science

Necessity is the mother of invention is an English proverb, and the appearance of modernization science may be taken as an example for it. Generally, modernization, a worldwide phenomenon and conception since about eighteenth century, refers to the frontier change of modern civilization and the international competition around the world (Fig. 1.1). It not only expedites the civilization progress and international differentiation and heightens the social productivity and quality of life, but also causes some side effects, etc. As an interdisciplinary one, modernization science deals with modernization phenomena, including modernization studies and modernization theories, etc. (Fig. 1.1).

1.1.1 What Is Modernization?

The English word “modernization” appeared approximately in the eighteenth century and was translated into Chinese in the early twentieth century. Modernization was widely used between the eighteenth and the nineteenth centuries and gradually became an academic term in the twentieth century. So far, modernization has been explained from three perspectives: the basic meaning, the theoretical meaning, and the policy implication.

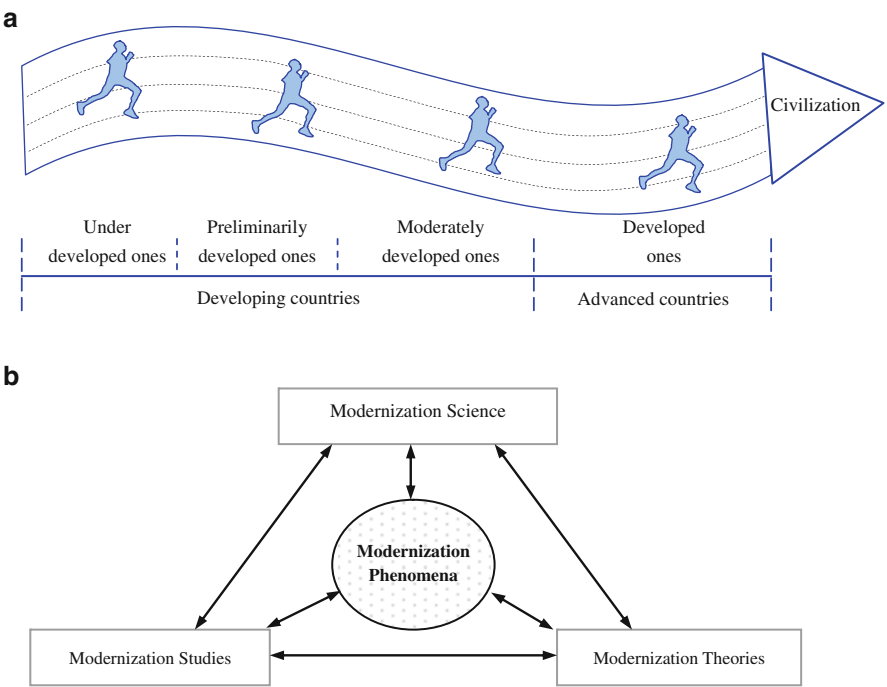


Fig. 1.1 Interaction between the modernization science and modernization phenomena. (a) Modernization movement is just like an international marathon in some content figuratively. (b) The relation among modernization science, modernization phenomena, modernization study and theories. Note: Modernization movement is just like an international marathon from the perspective of the national level (such as the level of the labor productivity, national development, and human development index) and international competition, figuratively, in which the countries running ahead become advanced or developed ones, while the rest become developing ones, and the developing ones may be divided into the three groups: moderately, preliminarily, and underdeveloped ones according to their status or level. There is some mobility among them. Hereinafter, the national level refers to the relative level of the development and transformation of national civilization in the world, international competition stands for the competition for catching up, reaching, or maintaining the world’s advanced level of national development and transformation around the world. Source: He (2010a, 2011)

1.1.1.1 Origin of the Concept of Modernization

According to Merriam-Webster Dictionary, “modernization” derives from “modern” which appeared in about the sixteenth century. These two words share similar basic meanings (Example 1.2).

Example 1.2 Origin of the Word “Modernization”

During the 185 years since the English adjective “modern” was created in about 1585, the “modernize” and finally its noun form “modernization” came into being in 1748 and 1770, respectively. There are two kinds of the basic meanings of the “modern”; one was the nature relating to present (or newest) and the other the time period since AD 1500. Based on them, it can be concluded that modernization refers to the act of becoming modern and meeting the modern needs and the states with that act finished.

Basic meaning of “Modernization” in English			
Item	Modern	Modernize	Modernization
Basic meaning	Adj. Date: 1585 1. Relating to or characteristic of the present or the immediate past 2. Of or relating to the period from approx. AD 1500 to the present	Verb. Date: 1748 1. To make or become modern 2. Make suitable for present-day needs	Noun. Date: 1770 1. The act of modernizing: the state of being modernized 2. Something modernized: a modernized version
Remark	Nature: latest (newest) in whatever field Time: have initiated point but no end	Being modernized (or becoming modern), satisfying the present needs	A kind of act (a process) A kind of state

Source: Merriam-Webster Online Dictionary (2009a, b, c)

Compared to the Middle Ages featuring the control of the church and feudalism, the sixteenth century witnessed great changes in the mind and life of European people, as the Renaissance was about to end. People at that time believed that a new “modern”¹ era had begun.

Profound changes in Europe had convinced people in the mid- and late eighteenth century that “having modern characteristics and satisfying modern demands” represented the new trend of social development, after a cluster of major movements

¹ When referring to time, modern is related to the division of historical stages. In European and American countries, historians divide the history into the ancient times (before AD 500), the Middle Age (AD 500–1500), and the modern times (after AD 1500) approximately, while the divided time has some change in different references. The mid-twentieth century saw a surge of “postmodernism” in these counties; therefore, the mid- and late-twentieth century is called by some the “postmodern” era. Some Chinese scholars divide the history into the ancient times (before 1840), the modern times (1840–1919), and the contemporary times (after 1919).

in Europe, including the Scientific Revolution from the sixteenth to the seventeenth century, the English Revolution in seventeenth century, the Enlightenment between the seventeenth and the eighteenth centuries, and the Industrial Revolution in Britain in the eighteenth century. Against such a background did the verb “modernize” come into being, and soon the noun “modernization.”

1.1.1.2 The Conceptual Evolution of Modernization

Between the eighteenth and nineteenth centuries, the word “modernization” was a common word to describe a social phenomenon. Integrating the meaning of “modernize” and “modern,” “modernization” has the following two basic meanings: (1) a kind of act, the behavior and process to satisfy the present needs or to be characterized by the present features; and (2) a kind of state, a state or version when present characteristics and needs have been met.

Chinese scholars began to explore China’s modernization in the 1930s. A total of 26 articles published on Shanghai-based *Shenbao Monthly* in 1933 discussed China’s modernization and proposed some basic concepts of modernization; for example, modernization meant industrialization, scientific progress, rationalization, professionalization, standardization, progress, democracy, better productivity and modern ideas, etc.

During the Cold War in the 1950s and the 1960s, the USA and Soviet Union tried to affect the development of the third world and new independent countries which had to choose the route of development. Under the support of the US Government and some foundations, American scholars began their research on modernization. The word “modernization” gradually became an academic term in social sciences.

And its meanings have been constantly changing and developing. In the 1960s, some American scholars regarded modernization a shift from traditional to modern society and another revolutionary transformation after the agricultural revolution in human affairs (Fig. 1.2), which includes the changes in knowledge, politics, economics, society, and psychology (Black 1966). But some early arguments about modernization have been criticized since the 1970s, which constantly enriched the connotation of modernization and yielded mushrooming new modernization theories.

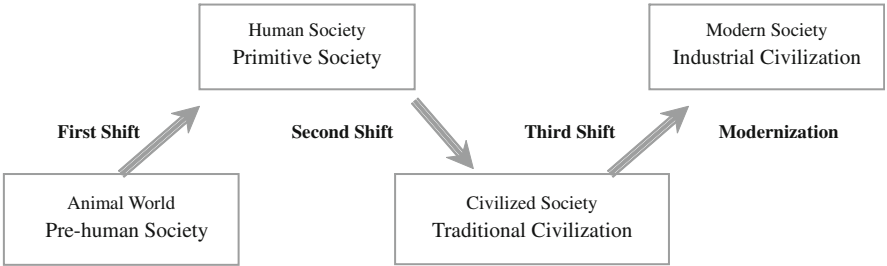


Fig. 1.2 Three revolutionary shifts in human affairs.
Note: Based on Professor Black’s ideas on the three great transformations of human affairs (Black 1966)

1.1.1.3 Three Explanations of Modernization

So far, modernization has been researched for over 50 years, but no agreement on its definition has been reached yet (Pandey 1988), as people's understandings in this regard vary. Generally, modernization is interpreted in three ways (Table 1.1), just like a box, you can see different views from different perspectives.

(1) The Basic Meaning of Modernization

It refers to the definition of the “modernization” in different dictionary. As defined in the English dictionary, modernization means a kind of act (process) or a state:

Table 1.1 Three explanations of modernization

Perspectives	Meanings
Basic meaning	As defined in the English dictionary, “modernization” has two basic meanings: (1) an act or process of becoming modern or meeting modern demands; (2) a state with modern characteristics or having met modern demands. Modern characteristics refers to new changes emerged from AD 1500 to date
Theoretical meaning	<p>American scholar Bendix regards modernization as a type of social change which started from the British Industrial Revolution and the French Revolution; it exists in the economic and political progress of several pioneer societies and the change of the follow-up societies (Bendix 1967)</p> <p>Eisenstadt, an Israeli scholar, regards modernization as process of transforming to modern social, economic, and political systems, which started from Western Europe and North America between the seventeenth and nineteenth centuries and spread to other European countries and finally to South America, Asia, and Africa in the nineteenth and twentieth centuries (Eisenstadt 1966)</p> <p>According to Prof. Luo, modernization, as a worldwide historical process, is a rapid change undergone by the human society since the Industrial Revolution in the broad sense. Driven by industrialization, it is a great transformation from traditional agricultural society to modern industrial society, during which industrialism has spread to spheres of economy, politics, culture, and ideology and caused profound changes. In the narrow sense, modernization means a process in which laggard countries catch up with industrial ones and adapt to the modern world (Luo 1993)</p> <p>In Prof. He's view, modernization is a frontier change of modern civilization and international competition since the Industrial Revolution in the eighteenth century; and from the eighteenth century to the end of twenty-first centuries, modernization process can be divided into two stages: The first modernization means the transformation and great changes from agricultural to industrial society, economy, politics, culture, and civilization; and the second modernization refers to the transformation and great changes from industrial to knowledge-based society, economy, politics, culture, and civilization. New changes will occur in the twenty-second century (He 1998a, b, 1999)</p>
Policy implication	It is the application of modernization theory in policy sphere, including the strategies, policies, and measures to promote the modernization. There are different implications of modernization theories in different countries, stages, and fields. For example, in developing countries in 1960s, the modernization theory was reflected in economic policies such as driving industrialization, standardization, production of scale, and modernization of agriculture, industry, science and technology and management, and in social policies such as promoting urbanization, enhancing social welfare and facilitating education modernization

Source: He (2003)

Generally, the former means the behavior (process) of becoming the latest, the best, and the most advanced, and the latter means the state with the behavior (process) completed. The word modernization is widely used in its different forms, for example, a modernized hospital (the adjective form), modernize the agriculture (the verb form), and the modernization of education (the noun form).

(2) The Theoretical Meaning of Modernization

It refers to the definition of “modernization” in different modernization theories. Generally, different theories interpret modernization in different ways. For example, sociologies view modernization as a social change which refers to the transformation from traditional to modern society²; historians regard it as a historical process; some scholars focus on interpreting the modernity or the state of having been modernized; and others think modernization is the change of civilization. That is quite like an allegory saying several blind people taking part of an elephant for the whole. Scholars often define modernization to enhance the operability of their research (Table 1.1).

(3) The Policy Implication of Modernization

It refers to the application of modernization theories in the policy domain and also the policy explanation of “modernization” in different nations. Different policies may reflect different theories, and one modernization theory may have different explanation in policy sphere in different countries, stages, and spheres (Table 1.1). As advanced countries and developing ones are in different stages and there is a wide gap between them (Example 1.3), their modernization policies are in quite different ways, which should be specially studied.

Example 1.3 Gap Between Advanced and Developing Countries

Since the eighteenth century, the gap between advanced and developing countries has changed in different aspects and stages. For example, it has been constantly widened in terms of per capita national income, widened first and then narrowed in terms of the urbanization level in last 300 years, and been gradually narrowed in terms of the proportion of agriculture, and
(continued)

² According to classic modernization theory, modernization refers to the transformation from traditional society to modern society, which may confuse people in two ways. The first is the relationship between “modernization” and “social modernization.” Generally, the former refers to the modernization of whole human society, while the latter refers to the modernization of the social sphere. The “human society” is a macro concept, and the “social field” is a micro one, but they are usually simplified as “society” without clear explanation in some papers. The second is the relationship between the two meanings of time and nature of the word “modern.” In terms of the time period, the modern means the time about since AD 1500, so 1960 is a modern time, and the societies in 1960 are all the “modern society.” It is not so, however, if the modern is interpreted from its nature: only the society featuring the characteristic of industrial civilization can be regarded as a modern society; without industrial civilization, the society is only a traditional one; so the societies in the year 1960 are not all the modern society. In the modernization science, “modern” refers to nature related to the characteristic of industrial civilization in general.

disappeared in terms of adult literacy in the twentieth century. This gap changes differently among developing countries and among advanced ones.

Such a gap between advanced and developing countries is wide as indicated in the comparison of some indicators. For example, it was particularly obvious in 2005, as on average, the per capita national income of high-income countries was 60 times that of low-income countries; the popularization rate of Internet of the former was over 10 times that of the latter; and the average life expectancy of the former (79) was 19 years longer than that of the latter (60).

Comparison between advanced and developing countries in 2005

Field, indicator, and unit		Advanced countries (examples)			Developing countries (examples)				Difference
		HIC	USA	UK	MIC	LIC	China	India	
Economy	National income per capita (USD)	35,014	43,210	38,140	2,646	583	1,740	730	60.1
	Proportion of agricultural added value (%)	1.5	1.2	0.9	9	22	13	18	0.1
Society	Average life expectancy (year)	79	78	79	70	60	72	64	1.3
	Proportion of urban population (%)	77	81	90	54	30	40	29	2.6
Politics	Proportion of government income (%)	26	18	37	18	13	10	13	2.0
	Proportion of government expenditure (%)	18	16	22	15	11	14	11	1.6
Culture	Adult literacy (%)	99	99	99	90	61	91	61	1.6
	Popularization rate of Internet (%)	56	67	53	11	4	9	5	14.0
Humans	Gross enrollment rate of tertiary education (%)	67	82	59	27	9	22	11	7.4
	Popularization rate of private cars (%)	47	46	46	5	0.8	1.5	0.8	58.8
Environment	Per capita energy consumption (kg oil equivalent)	5,498	7,893	3,884	1,486	486	1,316	490	11.3
	Per capita international trade (USD)	17,783	11,207	21,049	1,881	319	1,187	321	55.8

Note: (1) HIC, MIC, and LIC refer to high-income, middle-income, and low-income countries, respectively; (2) the proportion of agricultural added value is an inverse indicator, and lower value indicates more advanced, while others are positive indicators; (3) not all high-income countries are advanced ones, but the average value of these countries can reflect the level of advanced countries; (4) difference = average value of high-income countries \div average value of low-income countries; and (5) income from grant is not included in government income. The data of this table comes from the World Bank (2008)

(4) The Relationship Between the Three Explanations

The basic meaning remains unchanged, its policy implication change to keep pace with time, and theoretical meanings vary in different schools. Generally, policies are the embodiment of the theoretical meaning which is closely related to the basic meaning but has quite different implications.

For example, according to the second modernization theory, modernization has six theoretical meanings (Table 1.2), which are obviously related to the basic meaning, despite the remarkable differences in the connotation (Fig. 1.3).

The meaning of modernization has undergone five changes from its basic meaning to the theoretical meanings.

The first is the change of start time from the sixteenth century to the eighteenth century.

The second is the difference in the attribute from “latest and present” to “advanced and frontier.” The latest and the present may not have to be the advanced and the frontier in the world (Fig. 1.4).

Third, the state changes from “having met the modern needs” (state with modern characteristics and modern needs met) to the “world frontier of human civilization” (the state with advanced level in the world), the latter of which is defined more clearly. Besides, some modern features and needs do not necessarily represent the world frontier and direction of human civilization.

Fourth, the act of “becoming modern” (becoming modern and meeting modern needs) evolves to the act of “reaching the world frontier” (reaching the world’s advanced level), with the latter better defined. The latter can be divided into three groups: catching up with, reaching, and maintaining the world’s advanced level, which is not only independent but also an international competition.

Fifth, the process of “becoming modern” (becoming modern and meeting the modern needs) is changed to “reaching the world frontier” (reaching the world’s advanced level), and the latter is clearer. There are two paths to reach the world frontier: from the old to the new frontier and from the nonfrontier to the new frontier (Fig. 1.5). Two transformations of civilization are involved during this process: from agricultural to industrial civilization and from industrial to knowledge civilization.

From the perspective of civilization change and transition, all countries will make progress in and may succeed in modernization, but some may be fast and

Table 1.2 Theoretical meanings of modernization

Aspect	Basic meaning
Change	Modernization is the frontier change of human civilization since the Industrial Revolution in the eighteenth century, including the formation, development, transformation, and international interaction of modern civilization, as well as the innovation, selection, diffusion, and withdrawal of civilization elements, and so on
Competition	It also involves the international competition through which countries have tried to catch up with, reach, and maintain the world's advanced level since the eighteenth century. Those successfully reaching and maintaining the world's advanced level become advanced countries, while others, developing ones
State	It means the world frontier of human civilization since the eighteenth century (the world's advanced level)
Act	It is a kind of act to reach or keep the world frontier of human civilization since the eighteenth century
Process	It is a historical process to reach or keep the world frontier of human civilization since the eighteenth century. Between the eighteenth and twenty-first centuries, modernization process has undergone two stages with the first featuring industrialization, urbanization, and democratization and the second featuring the increasing role of knowledge and information and the enhancing awareness of environmental protection
Transformation	It is the transformation of civilization. The first modernization is the transformation from agricultural civilization to industrial one, including from agricultural economy to the industrial one, agricultural society to industrial one, agricultural politics to industrial one, and agricultural culture to industrial one. The second modernization is transformation from industrial civilization to knowledge one and from material civilization to eco-civilization, including from industrial economy to knowledge one, industrial society to knowledge one, industrial politics to knowledge one, industrial culture to knowledge one, and material culture to eco-culture
Formula	$\text{Modernization} \approx \text{civilization development} \times \text{civilization transformation} \times \text{international competition and differentiation}$ Modernization's connotation: the change of civilization and the international competition since the Industrial Revolution in the eighteenth century, including a frontier process of formation, development and transformation and international interaction of modern civilization, a composite process of innovation, selection, diffusion and withdrawal of civilization elements, and the international competition in which countries have tried to catch up with, reach, and maintain the world's advanced level and international differentiation. Modernization's denotation: It involves the modernizations in different stages, at different levels, in all fields, sectors, aspects, and types, including the modern changes of civilization behavior, structure, system, and ideas

Note: (1) There is no agreed definition about civilization. From the perspective of this operation, civilization is regarded as the achievements aggregate of human development since 3500 BC. (2) There is no unified classification of civilization either. According to the productivity level and the structure of civilization, civilization can be divided into agricultural civilization which is based on the agricultural economy, society, politics, and culture; industrial civilization based on the industrial economy, society, politics, and culture; knowledge civilization which features with knowledge-based economy, society, politics, and culture. The ecological civilization, which features ecological rationality and environmentally friendliness and constitutes a component or is an embodiment of knowledge civilization, includes eco-economy, eco-society, eco-politics, and eco-culture. (3) Changes of civilization include the frontier changes of human civilization and the civilizations of different countries and nations. The frontier changes of developed countries' civilization intersect with those of the human civilization, while those for developing countries are more of catching up with developed countries. While civilization changes also include the development and transformation of civilizations, world's advanced level of the development and transformation of national civilizations can be shortened as world's advanced level hereinafter. (4) Modern civilization may be interpreted differently. Some hold that the modern civilization means industrial civilization, while traditional civilization means agricultural civilization; both agricultural and industrial civilizations are material civilization; some others argue that modern civilization includes the primary modern and the hypermodern civilizations, the former refers to industrial civilization and the latter knowledge civilization. (5) The civilization transformation may be interpreted differently. First, transformation of modern civilization means to turn from industrial civilization to knowledge one and from material civilization to eco-civilization. Second, modern civilization has taken shape through transformation from agricultural civilization to industrial one

Source: RGCMS (2010), He (2010a)

	Basic Meaning	First Theoretical Meaning	Second Theoretical Meaning
Time	Approx. since the 16 th century	Approx. since the 18 th century	Approx. since the 18 th century
Nature	Latest, present	Modern, developed	Advanced, leading-edge, developed
State	Having met the modern needs	Modernity: level and features of industrialized countries	World frontier: world's advanced level
Act	An act of becoming modern	Act of transforming from tradition to modern	Act of reaching the world frontier
Process	A process of becoming modern	Process of transforming from tradition to modern	Process of reaching the world frontier
Essence	—	Social change	Change of civilization

Fig. 1.3 From basic to theoretical meanings of modernization.
Note: The first theoretical meaning is the interpretation of the classic modernization theory, while the second one is the explanation of the second modernization theory

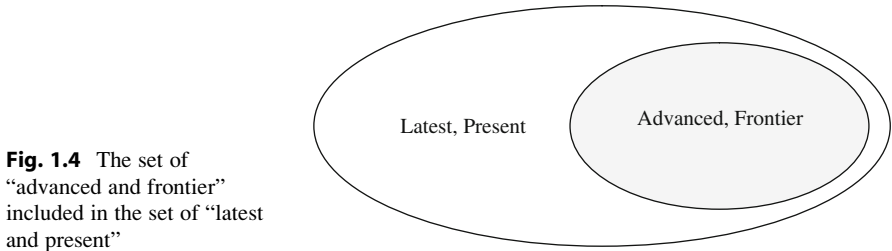


Fig. 1.4 The set of “advanced and frontier” included in the set of “latest and present”

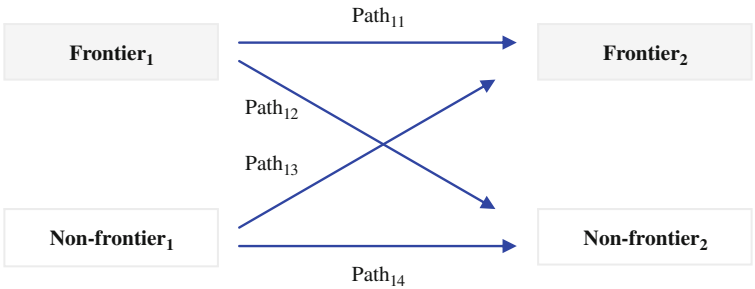


Fig. 1.5 Two paths to reach the world frontier. Note: Frontier₁ refers to the start of the world frontier (old). Frontier₂ means the terminal of the world frontier (new). Path₁₁ means the way from the old frontier to the new. Path₁₂ is the way from the old frontier to the nonfrontier. Path₁₃ represents the way from the nonfrontier to the new frontier. Path₁₄ refers to the way from the nonfrontier to the nonfrontier. Path₁₁ and Path₁₃ are the ways to maintain the world frontier and the catch up with the world frontier, respectively

other may be slow. In the past 300 years, modernization in different countries has been asynchronous.

From the perspective of world frontier and international competition, only some countries can reach and maintain the world frontier. In the past 300 years, advanced counties have accounted for less than 20%, while the percentage of developing

countries has been more than 80%; in a span of about 50 years, the probability that a developing country is upgraded to an advanced one is approximately 5%, and the probability that an advanced country maintains its status is about 90%.

From the theoretical perspectives, modernization is a type of civilization change and international competition since eighteenth century, and from the perspective of national level, modernization refers to the world's advanced level and the process to reach or keep this advanced level. The national level stands for the relative level of the development and transformation of national civilization in the international system. Generally, absolute level reflects the inner and vertical level of national development and transformation, while relative level is the level based on the international and horizontal comparison of the absolute level.

1.1.2 What Is Modernization Science?

As a new interdisciplinary one, the modernization science follows the rules for all sciences.

1.1.2.1 The General Concept of Science

The word “science” in the Western language appeared in about the fourteenth century and was translated into Chinese from English at the end of the nineteenth century. So far, there is no agreed definition of this word.

Example 1.4 What Is Science?

What is science? Many people expect an answer as simply as the question itself. However, the answer we need is quite complicated. In the human society, the seed of science is planted in human beings' inherent and ceaseless attempt to understand and control the world they are in through rational thinking and behaviors. Essentially, science is a social activity and rational thinking and behaviors, rather than loose corroborant knowledge, or a series of logics to acquire such knowledge (Barber 1952). In this point of view, science is a highly integrated concept which is closely related to corroborant and systematic knowledge and behaviors and ways to acquire this knowledge.

What kind of knowledge is within the scope of science? According to Overton, an American judge, a scientific theory shall have five features: in compliance with natural law; the capability of explaining phenomena according to the natural law; capability of being tested in the empirical world; conclusion is temporary, rather than final; and allowing falsification. That can be used as a standard to judge science (Bird 1998).

(continued)

Basic meanings of the English words “Science” and “Knowledge”		
	Science	Knowledge
Basic meaning	Noun	Noun
	Date: fourteenth century 1. The state of knowing: knowledge as distinguished from ignorance or misunderstanding 2. (a) Knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method; (b) such knowledge or such a system of knowledge concerned with the physical world and its phenomena: natural science 3. The investigation of natural phenomena through observation, theoretical explanation, and experimentation, or the knowledge produced by such investigation	Date: fourteenth century 1. The fact or condition of knowing something with familiarity gained through experience or association, acquaintance with or understanding of a science, art, or technique 2. The sum of what is known: the body of truth, information, and principles acquired by humankind 3. The state or fact of knowing, it applies to facts or ideas acquired by study, investigation, observation, or experience
Note	A knowledge system or a discipline about the world, which can be professional and be studied and learned; research activities to acquire professional knowledge	Aggregate knowledge of human beings about the world, especially that acquired by research, investigation, observation, experience, and reflection
Source: Merriam-Webster Online Dictionary (2009d, e)		

(1) The Basic Meaning of Science

According to scientific philosopher’s definition of science, science has three meanings.

First, it is a knowledge system about nature and society and has been tested and corroborated.

Second, it is about research activities to acquire the above-mentioned knowledge and knowledge system.

Third, it is a kind of thinking and methodology to acquire the above-mentioned knowledge system.

To put it simple, science is a knowledge system about nature and society and the research activity to acquire such knowledge, and the aggregation of scientific knowledge, research, thinking, and methodology. Neither nature nor society falls into the scope of science; only rational research and corroborant knowledge about them is science.

(2) The Disciplinary Structure of Science

Science is composed of a range of disciplines. But there is no unified way to divide these disciplines. For example, they can be divided into basic and applied science; natural and social sciences; and natural science, technological science, social

science, humanities, and interdisciplinary science. In some countries, mathematics, system science, logistics, statistics, and computing science are incorporated into formal sciences.

First, natural science deals with natural phenomena, such as material science, geosciences, and life science.

Second, technological science is the study of engineering techniques, like material science, engineering science, and the science of architecture.

Third, social science is about the study of human society, including economics, sociology, politics, psychology, and so on.

Fourth, humanities is about study of the state of human beings, such as history, linguistics, literature, and anthropology.

Fifth, interdisciplinary science refers to research on complex phenomena which involves many disciplines, such as system science, cognitive science, and environmental science. It does not mean the intersection inside natural, technological, social science, or humanities, but means to involve two or more of them, for example, the interdisciplinary science involving natural science and social science.

(3) Methods of Scientific Research

Basic methods of scientific research include observation, investigation, experiment, theoretical explanation, etc.

Scientific research usually includes a series of steps, the following four of which are universally followed.

First, collect true information and data by careful observation or investigation.

Second, propose preliminary theoretical concepts or assumptions by logic analysis and summary.

Third, test and correct theoretical assumptions by further experiment or observation.

Fourth, only the theoretical assumptions that have passed all the tests can be accepted as a scientific theory.

Scientific attitude is the soul of scientific activities, with emphasis upon the justice of rationality, accuracy, and no bias.

1.1.2.2 Definition of the Modernization Science

The modernization science is a branch of science that deals with the modernization phenomenon, and a new member of the interdisciplinary science. The modernization phenomenon is a world movement including the frontier changes of modern civilization and international competition since eighteenth century; it involves two aspects: the world frontier and frontier changes of modern civilization, the process and act to catch up with or reach the world frontiers.

According to the definition of science, the modernization science has the following three meanings:

First, modernization science, as a knowledge system, is about the facts, features, and principles of the modernization phenomenon.

Second, modernization science, as a social activity, refers to the scientific researches on the modernization phenomenon.

Third, modernization science, as a thinking and approach, refers to the rational thinking and approach applied to the modernization research.

To put it in simple words, the modernization science refers to the knowledge system and scientific research concerning the modernization phenomenon, including modernization researches and modernization theories.

Figuratively, the modernization science is an interdisciplinary one that deals with the world frontier and national advancement since the eighteenth century, which includes the frontier change of modern civilization and international competition, the principles and methods of national advance.

The modernization science could be shortened as modernizations.

1.1.2.3 The Significance of the Modernization Science

The modernization science is a strategic science, which helps us to understand the world frontier of modern civilization and international competition as well as the principles of and approaches to national advancement, and fosters the awareness of an overall picture and strategic thinking. Its important role is embodied at three aspects: the theoretical, the practical, and the social aspect.

First, at the theoretical aspect, it helps understand and explain the modernization phenomenon, specifically speaking, including understanding the world frontier of modern civilization, revealing the laws of world frontier change, and explaining the general principles of national advancement.

Second, at the practical aspect, it provides principles of and approaches to national advancement, specifically speaking, including the knowledge, principles, approaches, and countermeasures required for national advancement; the theoretical basis and historical experience for national strategy and planning; and the all-round talent to meet strategic needs for modernization.

Third, at the social aspect, it satisfies people's curiosity about the modernization phenomenon. It provides answers to the questions people are asking, such as why some countries are advanced while others are not? How do advanced countries stay advanced? And how can developing countries become advanced?

The emergence of modernization science is not only the natural result of the modernization study through about 50 years but also fit to the need of the world modernization and the international competition in the twenty-first century.

1.1.3 Natures of Modernization Science

The modernization science is a new member of the big family of sciences. It is an interdisciplinary one and also an applied one. It not only explains the world frontier of human civilization and its changes but also analyzes national advancement and international competition; it not only crosses with all the other sciences but also involves the integrated application of them. It is a highly interdisciplinary and integrated big science. Here address its structure and characteristics briefly.

1.1.3.1 Structure

Modernization involves the profound changes occurring in all the aspects of human life since the eighteenth century, but it does not mean that modernization science excludes nothing. In fact, only the knowledge acquired from the study of modernization, tested and systematized, belongs to the modernization science; the knowledge of modernization and the modernization study constitute two pillars of the modernization science (Fig. 1.6).

(1) The Basic Structure

Generally, the modernization science includes modernization research and modernization knowledge (Fig. 1.6), and the latter involves experienced and theoretical knowledge. The experienced knowledge refers to the general understanding about the facts and features of modernization coming from historic and present practices and studies, while the theoretic knowledge refers to the basic definitions and principles of modernization and is a collection of all kinds of modernization theories.

The modernization theory provides theoretical abstraction and explanation of the modernization phenomenon. Modernization involves the all-round changes of human civilization, but the modernization study often begins with a certain aspect. The knowledge derived from researches conducted from different perspectives varies, and thus, different theories of modernization are formed. That is why the modernization theory does not stand alone but is a cluster of theories.

As far as the modernization science is concerned, modernization research and modernization theory are closely related. The modernization theory is not only the fruit of modernization research but also provides an analytical framework for it; the two of them support and evolve with each other. Meanwhile, though the modernization research and the modernization theory have their own structures, they are connected.

(2) The Research Structure

According to the objects and natures of the study, the modernization study can be classified into three clusters: the basic, applied, and development research (Fig. 1.7). However, the division is not fixed and absolute; sometimes the three clusters can overlap with each other. The modernization study can be integrated and serve multiple purposes on some occasions.

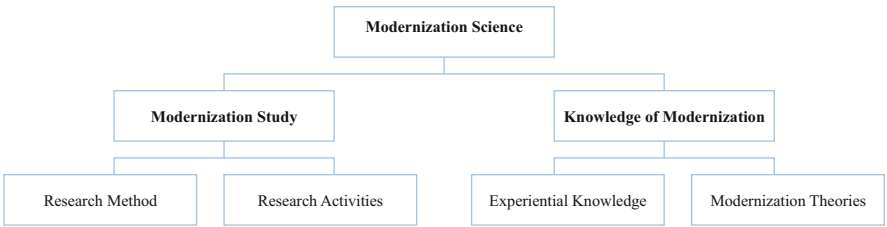


Fig. 1.6 Basic structure of the modernization science.

Note: The method employed in modernization research is also a kind of modernization knowledge

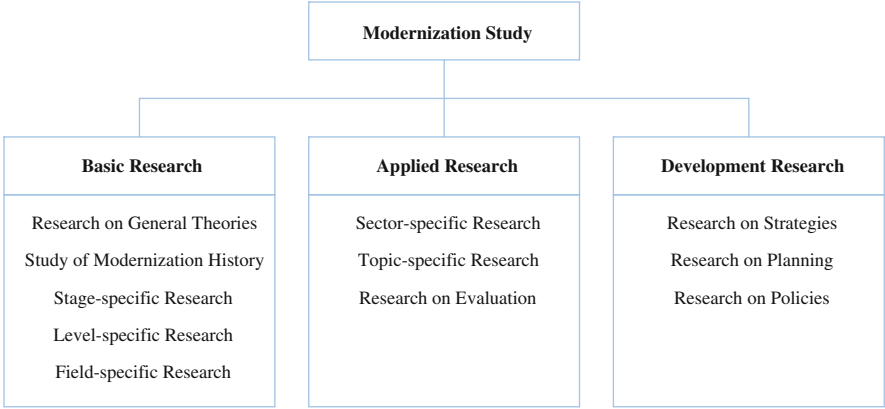


Fig. 1.7 Internal structure of the modernization research.
Note: The division is not fixed and absolute; the three clusters may overlap with each other. Some topic research such as the modernity study also belongs to basic research, and some topic research such as the urbanization study belongs to the applied research. Evaluation is a research method and can be regarded as part of the basic, applied, and development research

Basic research studies on general nature and principles of modernization, identifies the world frontier of human civilization, explains the laws of change of the civilization frontier, and provides general principles of national advancement.

Applied research studies on general way and approaches of modernization, identifies the world frontier in a certain aspect, and illustrates the ways and approaches to maintain or reach the world frontier and to realize national advancement.

Development research (or policy research) studies and provides the strategies, planning, polices and measures, etc., concerning modernization.

(3) The Theoretical Structure

As a scientific theory, the modernization theory needs to respect the scientific standards. Generally, a scientific theory has the following three features: the ability to describe and explain objective phenomena precisely and accurately, the ability to forecast and be testable, and beautiful and simple forms. The modernization theory generally includes the systematic illustration of the definition, process, result, dynamics, and models of modernization that can stand the test.

According to the illustrated objects and natures of theories, the modernization theory can be classified into three clusters (Fig. 1.8), namely, the cluster of basic theories, applied theories, and relevant theories. However, the division is not fixed or absolute; the three clusters can overlap with each other sometimes. For example, some relevant theories may belong to the cluster of basic theories or that of applied theories.

The modernization study has so far had a history of over 50 years, producing a range of modernization theories, which can be sorted and categorized according to the internal structure (Fig. 1.9) and constitute a key basis for the modernization science.

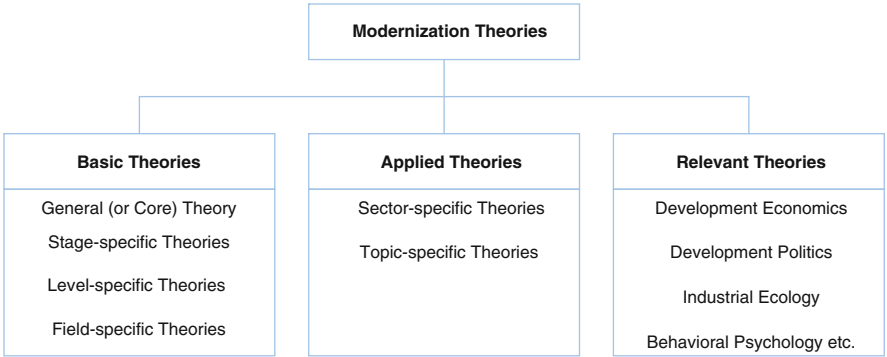


Fig. 1.8 Internal structure of modernization theories.
Note: Some theories regarding specific topics such as the modernity belong to the cluster of basic theories, and some such as the urbanization theory belong to the cluster of applied theories. Relevant theories refer to the existing theories in natural science, technical science, social science, humanities, and other interdisciplinary sciences, which can be used to illustrate and explain certain phenomena of modernization and can also be directly borrowed by the modernization science to avoid redundant research

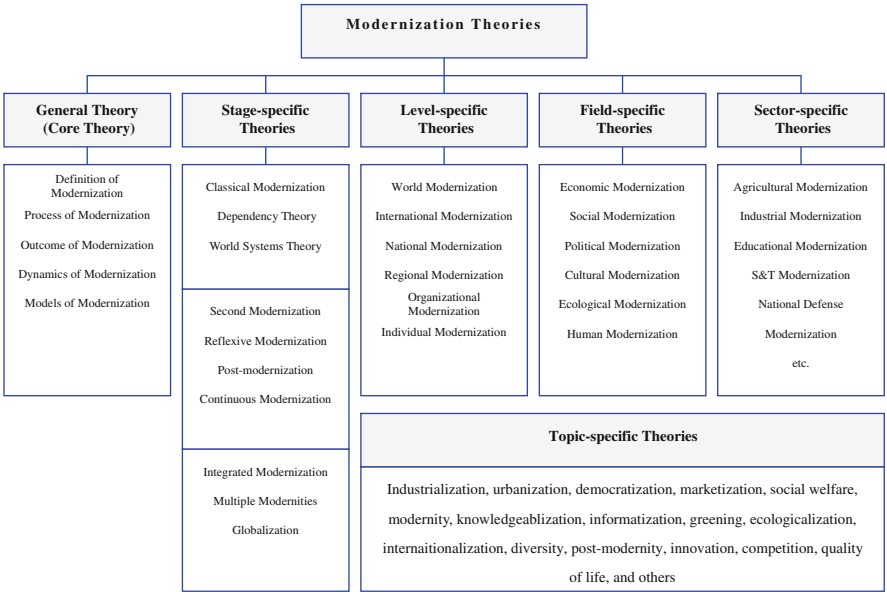


Fig. 1.9 System of modernization theories.
Note: The division is not fixed or absolute. Integrated modernization does not happen in the third stage of modernization, but a path paralleling the second stage of modernization, specifically referring to the modernization of developing countries. Generally speaking, when advanced countries are in the second stage of modernization, developing countries might still be in the first stage or adopt the model of coordinated development of twice modernization. That model is the path of integrated modernization of developing countries, which coexists with the second stage of modernization of advanced countries.
Source: He (2010a, 2011)

(4) The Disciplinary Structure

According to the definition of science, systematic modernization research and theories are the basic components of the modernization science. The disciplinary structure of the modernization science can be extracted by integrating the structure of modernization research and modernization theories (Fig. 1.10), which includes the following seven parts: the general theory (modernization theory), the history of modernization, stage-specific modernization, level-specific modernization, field-specific modernization, sector-specific modernization and modernization policies, etc.

1.1.3.2 Characteristics

The modernization science involves the civilization frontier and national advance, can be and needs to be analyzed from multiple perspectives.

(1) Modernization Science as an Interdisciplinary Science

The modernization science is one about the world frontier of human civilization and its changes. The change of civilization involves the development and application of all the sciences. It has both abundant internal and external crossover.

First, the internal crossover. The internal disciplinary crossover, such as the crossover between modernization at different stages and the modernization on

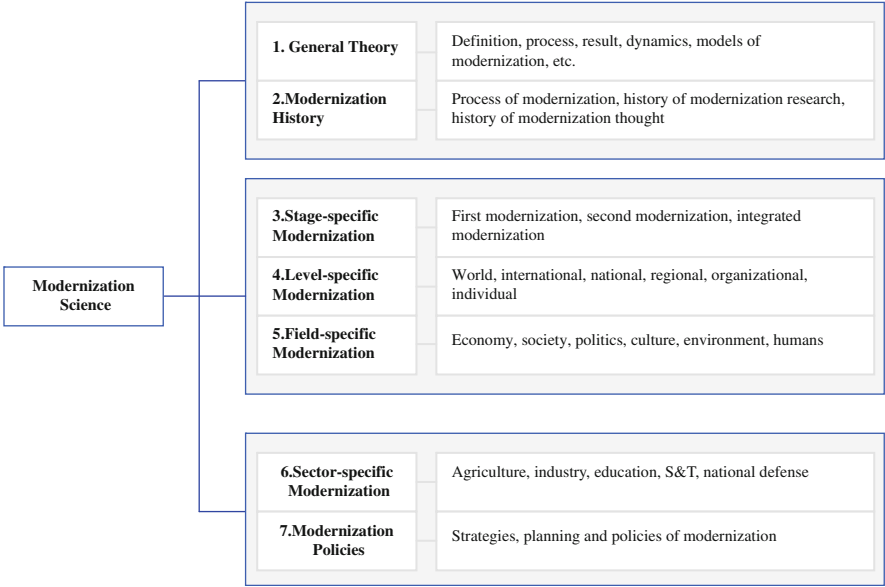


Fig. 1.10 Disciplinary structure of the modernization science.
Note: The general theory of modernization can be shortened as modernization theory or core theory. The environment refers to the natural environment here. The process of modernization refers to the frontier trajectory of human and national civilization since the eighteenth century.
Source: He (2010a, 2011)

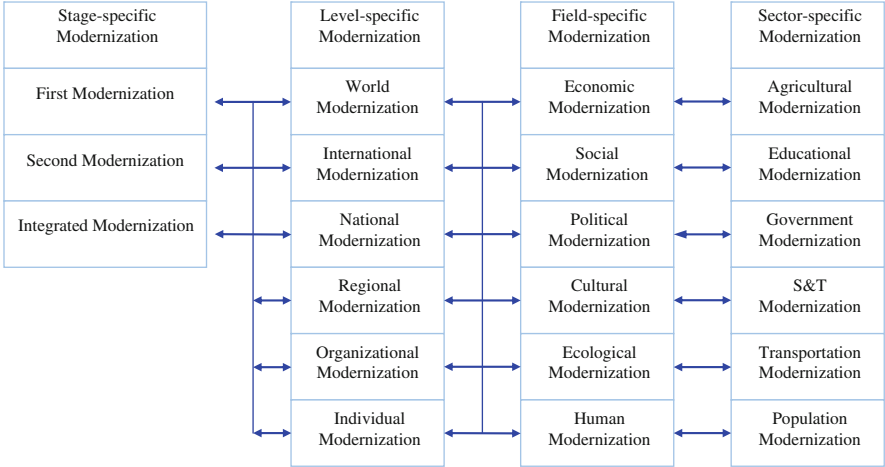


Fig. 1.11 Internal crossover of modernization science (schematic diagram).
Note: The world modernization has crossover with economic, social, political, cultural, ecological, and human modernization and other crossover can be deduced in the similar way

different layers and in different fields and sectors, overlaps between stratified modernization and modernization in different fields and sectors and overlaps between field-specific modernization and sector-specific modernization (Fig. 1.11).

The crossover of the different researches, such as the crossover between the basic and applied research in the modernization science and that between applied and development research.

The crossover of the different theories, such as the crossover between the general theory, stage-specific theories, level-specific theories, field-specific theories, and sector-specific theories.

The interaction between research and theories. The modernization research is the source of modernization theories, and the latter is the product of the former and provides research framework or guidance for former. They promote each other in a mutual way.

The interaction between theory and practice. Modernization theories provide theoretical guidance for modernization practice, and the latter provides the former with research objects. They interact with and promote each other.

Second, the external crossover of the modernization science. The modernization science is one about the world frontier. Generally, different disciplines have different world frontiers (those of research subjects and contents). The crossover between the modernization science and other sciences involves the frontier as well as the contents.

The crossover between the modernization science and natural and technical sciences. The world frontier of modern science and technology and that of human civilization are closely related. Scientific and technological progress is the driving force and intellectual source of modernization. There are a lot of crossovers between the modernization science and modern science and technology, such as the crossovers between economic modernization and high technology, ecological modernization and ecology, and agricultural modernization and agricultural science and technology (Fig. 1.12).

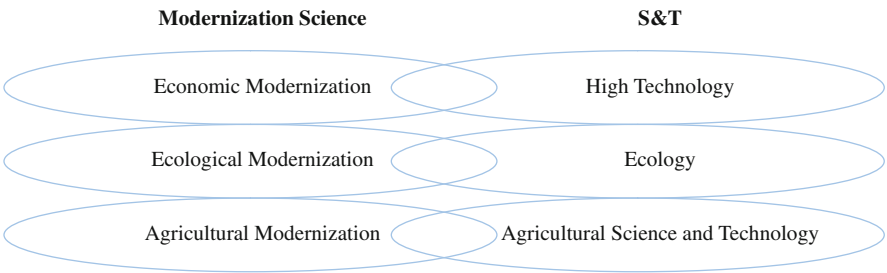


Fig. 1.12 Crossover between the modernization science and natural and technical sciences (schematic diagram)

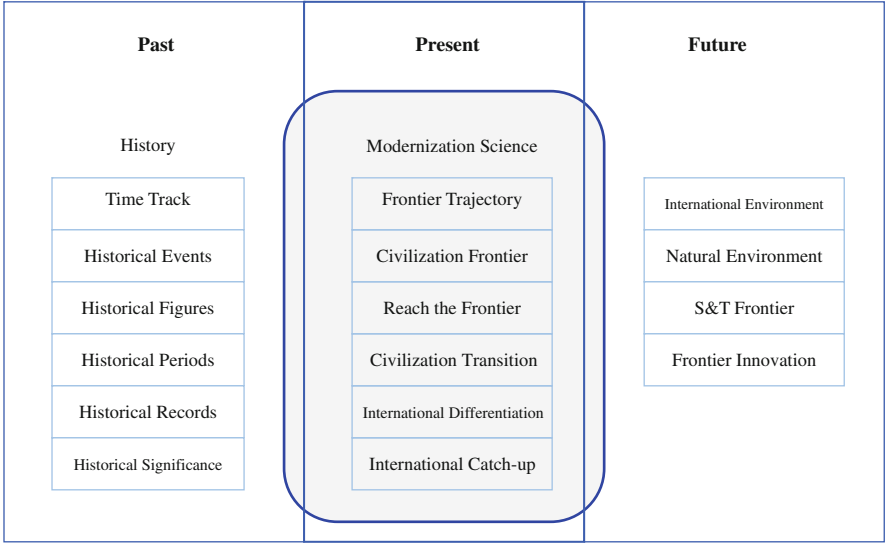


Fig. 1.13 Crossover and difference between modernization science and history (schematic diagram). Note: Relatively, history (Merriam-Webster Online Dictionary 2009f) focuses on the time track and significance of history, while modernization science focuses on the frontier trajectory of history and principles of national advancement

The crossover between the modernization science and humanities and social sciences. The world frontier of humanities and social sciences involves that of their research objects and contents and is closely related to that of human civilization. There are a lot of crossovers between the modernization science and humanities and social sciences, such as that between modernization science and history (Fig. 1.13), economic modernization and economics (Fig. 1.14), political modernization and politics, cultural modernization and culture study, and human modernization and psychology.

Third, the crossover between the modernization science and other interdisciplinary sciences, such as the crossover between regional modernization and economic geography, ecological modernization and environmental science, science and

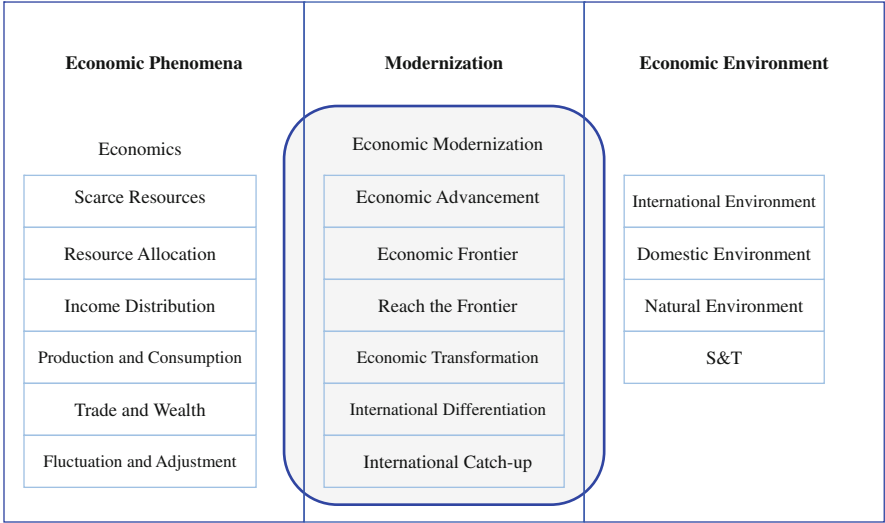


Fig. 1.14 Crossover and difference between economic modernization study and economics (schematic diagram).

Note: Relatively, economics (Samuelson and Nordhaus 1992; Merriam-Webster Online Dictionary 2009g) focuses on the allocation of scarce resources, while the research on economic modernization is interested in the principles of economic advancement

technology modernization and the science of sciences, and management modernization and system science.

(2) Modernization Science as an Applied Science

The science of modernization is one about national advancement and international competition and closely related to national construction and international stratification and differentiation.

First, the practical value of modernization science. Before the 1970s, the modernization study paid more attention to the developing countries, especially those newly liberated from colonization, as the objects. These countries found classical modernization theory either practical value or useful as a reference source. However, for advanced countries, the classical modernization theory was of value only in the field of international policy, not in domestic policy, for by that time, they had completed classical modernization, whose historical experience helped develop concepts of classical modernization theory.

Since the 1970s, there have emerged new theories of modernization, including the postmodernization theory, ecological modernization theory, reflexive modernization theory, multiple modernities theory, second modernization theory, etc. They are of practical value and useful as a reference source to both advanced and developing countries for they represent the world trend and direction.

In fact, these new theories on modernization are of plain practical value to advanced countries for the following two main reasons. For one thing, advanced

countries, having completed classical modernization, need new theories to guide them or to refer to. For another, most of the advanced countries are democratic countries, whose periodic democratic elections provide opportunities for the application of new modernization theories. For example, the Green Party in Europe once adopted the theory of ecological modernization as their policy guideline during the election campaign.

Second, the differences between modernization science and development study. Modernization science and development study differ in a lot of aspects (Table 1.3). Simply speaking, the former studies phenomenon of national advancement, focusing on the world frontier of human civilization and principles of national advancement, while the latter is about developing countries, about the development and policies of the third world. They are overlapped with certain differences.

Table 1.3 Comparison between the modernization science and development study

Aspect	Modernization science	Development study
Category	A discipline of interdisciplinary science	A interdisciplinary discipline of social science
Features	Advancement study	Development study
	Science of advancement	Science of development
	Study of the civilization frontier	Study of the third world
	Combination of the past, the present, and the future	Focus on present and future, applied study
	Pay attention to the world frontier and international differentiation of human civilization	Pay attention to the national development and international relations of developing countries
Objects	The frontier changes of human civilization and international competition since the eighteenth century	Changes of developing countries since the twentieth century
	The formation, development, transformation, and international interaction of modern civilization	Development issues of developing countries
	International competition to catch up with, reach, and maintain the world's advanced level	Economic, social, and political development of developing countries
Priorities	Principles and methods of the national advancement	Development and policies of the third world
	World frontier and long-term trend of human civilization	Application of western social science in the third world
	Why are advanced countries advanced?	Economic and political development and modernization of developing countries
	How do advanced ones maintain the advanced level?	Theories, management, and policies of development
	How can developing ones become advanced?	Area study, etc.
Methods	Multi-, cross-disciplinary, and interdisciplinary study	Multi-, cross-disciplinary, and interdisciplinary study
	Integration of natural science and social science	Integration of social science and humanities

(continued)

Table 1.3 (continued)

Aspect	Modernization science	Development study
	Research that varies in stages, at levels, or in fields	Research that varies in countries, regions, and fields
	Logic: international comparison, competition, relative	Logic: Historic comparison, progress, absolute
	International comparison based on civilization time and advanced level or world frontier	Historic comparison based on physical time
Theories	Classical modernization theory, postmodernization theory, ecological modernization theory, reflexive modernization theory, multiple modernities theory, second modernization theory, etc.	Classical modernization theory, dependency theory, world systems theory, state theory, development theory, imbalanced development theory, balanced development theory, development economics, etc.
Scope	Advanced countries and developing countries	Developing countries and the third world

Note: There is no single definition on the development (Merriam-Webster Online Dictionary 2009h) study. Civilization time is one marked by the frontier trajectory of human civilization

Source: He (2010a, 2011)

If development study is a science about the development of developing countries, then modernization science is one about national advancement. The former focuses on the changes of developing countries and the development of the third world, while the latter focuses on issues such as why some countries were advanced and others were not, how advanced countries stay advanced, how developing countries become advanced, and the world frontier and its changes of human civilization.

(3) Modernization Science as an Integrated Science

Modernization science is an integrated science or complex science about civilization frontier and national advancement. Like any other integrated science, it is highly interdisciplinary and integrated, large-scaled, theoretically, and strategically grand (Table 1.4).

First, features of modernization science from the perspective of modernization phenomenon. As a complex phenomenon, modernization involves the world frontier of human civilization and the process to reach it and the international competition to catch up with, reach, and maintain the world's advanced level. Science, innovation, competition, and exchange play vital roles in the modernization process. From the perspective of modernization phenomenon, the modernization science is complex, forward, international, interdisciplinary, and integrated.

Second, features of modernization science from the perspective of modernization research. Modernization research is the research activity of modernization science. The features of the former affect and constitute the features of the latter, such as being empirical, interpretive, descriptive, practical, international, interdisciplinary, and openness. Generally, modernization research did not spring up

Table 1.4 16 Features of the modernization science

No.	Feature	Explanation
1	Highly interdisciplinary	Modernization science is highly interdisciplinary involving all the other sciences
2	Highly integrated	Modernization science is highly integrated involving the application of all the other sciences
3	Large-scaled	Many modernization study is conducted on a large scale, covering a large span of time or space
4	Theoretically grand	Modernization theory is a grand theory, explaining the grand transformation of human civilization
5	Strategically grand	Modernization science explains the great trend of human civilization and provides strategic options for national advancement
6	Complex	Modernization is a complex phenomenon and modernization science is a complex science
7	Forward	Modernization involves the world frontier and the process to reach it
8	Practical	Modernization is a practical issue, modernization theories have a lot of implication of policy
9	International	Modernization is a world phenomenon, involving the international interaction, differentiation, stratification, and international catch up since the eighteenth century
10	Openness	Modernization is a dynamic process since the eighteenth century; the modernization study is not limited to certain disciplines but open to all of them
11	Empirical	Some modernization study is empirical, such as quantitative study and case study
12	Interpretive	Some modernization study is interpretive, lack of empirical basis
13	Descriptive	Some modernization study is descriptive, lack of theoretical basis
14	Diversified	There are multiple theories on modernization without a universally agreed theory so far
15	Stratified	The theory of modernization is stratified with country as the basic unit
16	Experiential	Some theories of modernization are summarized based on historical experience

Source: He (2010a, 2011)

until the 1950s. Early modernization research was marked with humanities and social sciences. But since the 1970s, with the development of environmental protection, information revolution, and knowledge economy, the connotation of modernization has undergone profound changes, and modernization science has become an interdisciplinary science with various flourishing schools of modernization research.

Third, features of modernization science from the perspective of modernization theory. Modernization research and modernization theories are two independent and interactive parts of modernization science. The former, as the main body of the knowledge of modernization science, will inevitably affect and constitute the features of modernization science, such as being macro, integrated, strategic, diversified, stratified, experiential, and practical. The theory of modernization does not stand alone but a collection of theoretical achievements of various schools of modernization research.

1.2 Methodology of Modernization Science

An ancient Chinese had said “A thousand kilometer journey begins with the first step.” This section will discuss the methodology of the modernization study in a general sense, and which is the foundation of the following chapters on their research methods.

1.2.1 Paradigm of Modernization Study

In the twentieth century, modernization study fell into the category of social science or humanities, and the research paradigm of social science or comparative history was usually adopted. In the twenty-first century, as a cross-disciplinary study, it can make the form of its own paradigm and analysis structure (Fig. 1.15).

1.2.1.1 Objective

All countries used to be agricultural until the eighteenth century, and the emerging industrial civilization began to change the world structure. With only a few exceptions, agricultural civilizations have declined since then, while industrial

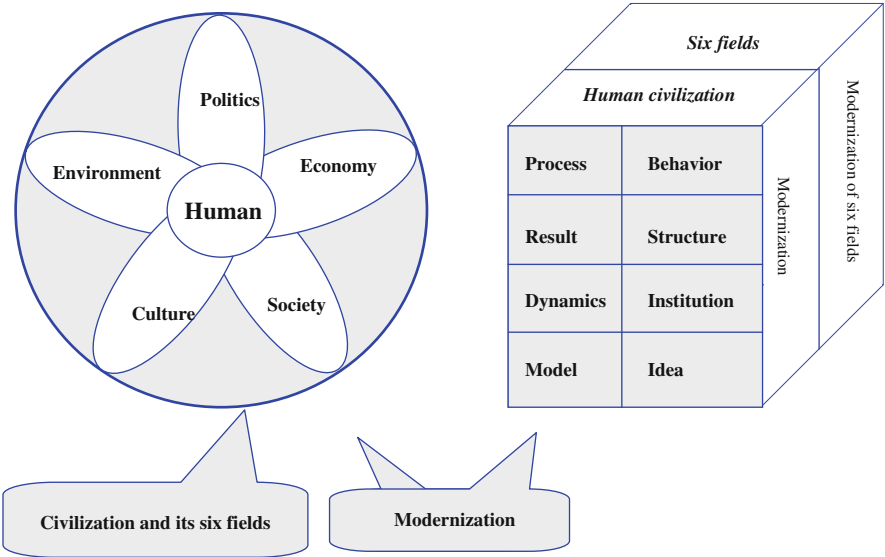


Fig. 1.15 Analysis structure of human civilization and modernization study (schematic diagram). Note: Human civilization is an organic whole and also a collection of the civilizations of all nations. The study on human civilization and modernization can be conducted by field or by country. The six major fields, including economy, society, politics, culture, environment, and human, are parallel, both independent and overlapping. The analysis structure abovementioned is for operational purpose; incomplete though, it is useful as an analysis framework. Source: RGCMS (2005, 2006, 2010)

Table 1.5 Purpose of modernization study

Item	Scientific meaning	Academic purpose	Applied purpose
Modernization science	An interdisciplinary science that explores and explains modernization phenomena	To study the rules of frontier change of human civilization, the principles and method of modernization	To supply the approaches of modernization, the knowledge about modernization
Basic research	Studying modernization principles and establishing modernization theories	Finding out general attributes and rules of modernization	Accumulating modernization knowledge and solving related problems
Applied research	Studying modernization methods and explaining its approaches	Elaborating general approaches and methods of modernization	Offering approaches and methods of modernization
Policy research	Testing modernization theories and methods	Testing modernization theories and methods	To offer modernization strategies, plans, policies, suggestions, etc.

Note: The research activities of modernization science are divided into basic research, applied research, and policy research in a relative way, and comprehensive research in many cases

countries continue to prosper (Example 1.5). In the twentieth century, most industrial nations were developed countries, while all agricultural countries were developing ones. Why and what are the principles and methods underlying national prosperity in the twenty-first century? To answer these questions in a scientific way is the main purpose of modernization research. The research activities of modernization science (modernization study) can be divided into basic research, applied research, and policy research, depending on their varying purposes (Table 1.5).

Example 1.5 International Differentiation of the Countries

Modernization is a profound change of human civilization since the Industrial Revolution. During the 150 years (1763–1913) of the Industrial Revolution, the world underwent fundamental structural changes; some emerging industrial countries became developed and imperialist nations, while some traditional agricultural empires became developing countries (regions) or colonies (semicolonies), and America rose from a colony to become a developed country and an industrial power. From 1700 to 1913, international ranking and disparity in terms of GDP (PPP) per capita was significantly changed, for example, in 1700 China’s GDP (PPP) per capita came after Britain, but before India and America, while in 1913 the ranking changed to America, Britain, India, and China; also during this period, GDP (PPP) per capita increased by 2.5 times in industrial countries (12 Western European countries), tripled in Britain, and grew ninefold in America; many agricultural countries underwent little or negative growth; for example, the GDP (PPP) per capita increased by 22% in India but dropped by 8% in China. All these led to a much widened rich–poor gap in the world.

1700–1970 Comparison between four countries

Item	GDP (PPP) per capita/at 1990 international dollar price					Rank in terms of GDP (PPP) per capita				
Year	1700	1820	1870	1913	1970	1700	1820	1870	1913	1970
America	527	1,257	2,445	5,301	15,030	51	6	4	1	3
Britain	1,250	1,707	3,191	4,921	10,767	2	2	1	5	12
India	550	533	533	673	868	50	73	72	72	90
China	600	600	530	552	783	18	48	73	104	92

Note: A total of 104 countries and regions are ranked, and in some cases, a regional average is used for a country's GDP (PPP) per capita in given years. In 1700, America was a colony of Britain (it became independent in 1776), and Britain, India, and China were all agricultural countries; Britain was the power in Europe, while India and China were the powers in Asia. In 1913, America and Britain became developed countries and major industrial powers in the world and in Europe, respectively, while India, colonized by Britain, and China, a semicolony, were developing nations (or regions). The data of this table comes from Maddison (2001)

(1) Academic Purpose

Modernization studies may fall into different categories and serve different purposes.

First, generally, modernization studies attempt to acquire modernization knowledge, both experimental and theoretical, and to establish the framework and paradigm of modernization science. Experimental knowledge includes the facts, features, and experiences of modernization; and theoretical knowledge covers all kinds of modernization theories about the universals, rules, and principles underlying modernization phenomena.

Second, to produce professional researchers is one of academic purposes of modernization research.

Third, specific research programs may have different academic purposes.

(2) Practical Purposes

The modernization studies, of practical use, allow various purposes for different researches.

First, generally, it attempts to provide modernization knowledge, methods, and solutions. Among them, the first one includes experimental and theoretical knowledge, for example, basic theories and historical experiences and lessons; the other two refer to approaches, strategies, plans, and policy recommendations for modernization.

Second, for developed countries, the major practical purpose is to grasp the knowledge and tools to maintain their advanced level.

Third, for developing countries, the major practical purpose is to obtain the knowledge and tools to become developed countries.

Modernization study also tries to satisfy people's curiosity about modernization phenomena and answer their questions, for example, which countries are developed ones? Why are they developed countries? What is the level of our own country? Can developed countries maintain their advanced level, or be degraded to developing countries? Can developing countries become developed ones? And so on.

1.2.1.2 Scope

No consensus has been reached on the scope of the modernization study. Generally, it involved the object, content, and the relation between each other, and the division of the two is relative.

(1) Object

Apparently, modernization phenomenon is the object of modernization study. Modernization usually has three explains, namely, basic literal meaning, theoretical implication, and policy meaning. Theoretical implications are different in various theories. The second modernization theory holds that modernization reflects a change of not only civilization but also the international competition. Civilization is the sum of human's achievements since 3500 BC in general sense, and its changes involve all aspects of people's life; therefore, it is impossible and irrational to make all changes in human civilization since the eighteenth century the objects of modernization research. As a matter of fact, the frontier of civilization since the eighteenth century and how to reach this frontier is the major object of modernization research.

First, the limits of modernization. In line with the basic literal meaning and theoretical implication, modernization has two limits in time and nature, respectively.

The first is the time limit: Modernization refers to changes of civilization since the eighteenth century, not those that had occurred before.

The other limit is about the nature: Modernization must be about new and cutting-edge changes; those other than the civilization frontier are not modernization.

Accordingly, it can be inferred that not all changes of human civilization are the objects of modernization research, but only the frontiers and frontier changes of the civilization in the world since the eighteenth century and the process and behaviors to reach the frontier are (Fig. 1.16).

Second, the category of the objects. The modernizations refer to the changes in different time period, fields and aspects, and at various levels (Fig. 1.17); therefore, the research objects can be further classified (Table 1.6).

Third, the content. Modernization means the world frontiers of human civilization since the eighteenth century and the process and efforts to reach this frontier in short word. The connotation, features, and rules of modernization are the major contents of modernization research.

The world frontiers of human civilization are dynamic, and the process and efforts to reach it are complex, so research can and should be done from various perspectives. The research contents can be classified according to the purpose and nature of the research (Table 1.7).

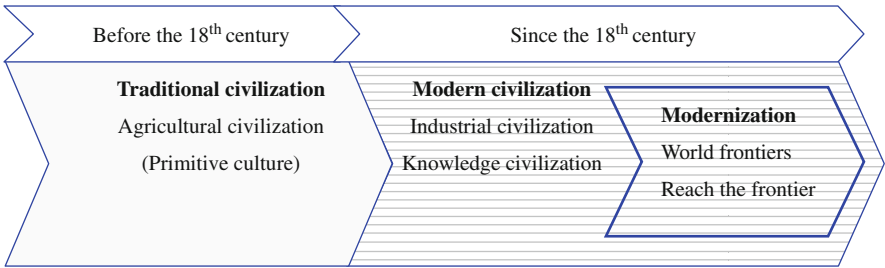


Fig. 1.16 Relationship between civilization and modernization (schematic diagram).
Note: On the international level, some countries that reached or are keeping the world’s advanced level of human civilization become developed countries, while others become developing countries. Nationally, the cutting edge of the civilization of developed countries may represent not only the most advanced level of their own but also that of the whole human civilization; but that is not true for developing countries which are trying to catch up with developed countries. Of course, that is not absolute; developed countries may be laggard in some aspects, while developing one may be advanced in particular fields

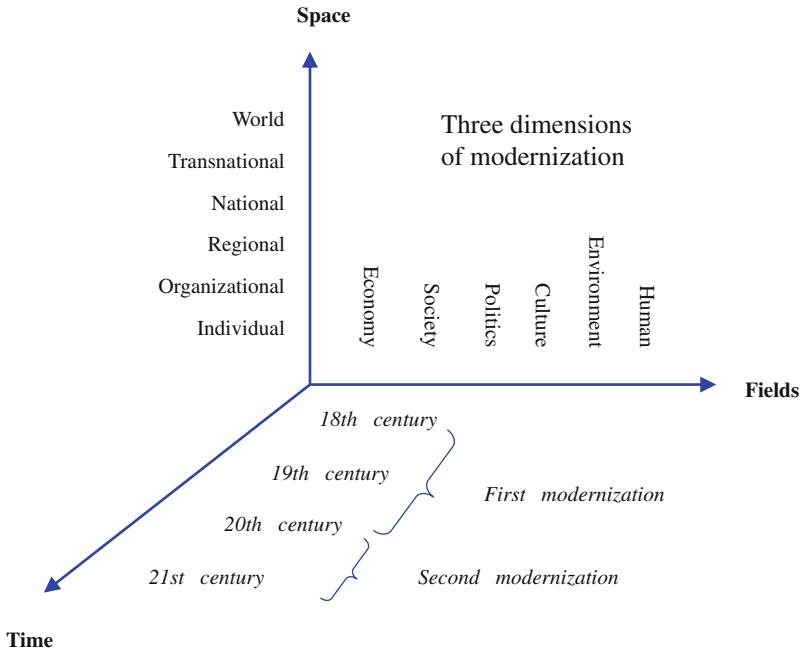


Fig. 1.17 Three dimensions of modernization.
Source: RGCMS (2010)

Fourth, the research matrix. There are three matrixes generally. One is the matrix of research scale and unit (Table 1.8), the other is the matrix of research objects and contents (Table 1.9), and the last is the matrix of fields and sectors (Table 1.10).

Table 1.6 Category of objects for modernization study

Dimension	Description
Time	Modernization, the first modernization, the second modernization, and the integrative modernization
Space	Six levels: world, transnational, national, regional, organizational, and individual modernization
Field	Six fields: modernization of economy, society, politics, culture, environment, and human Sectors: modernization of agriculture, industry, education, science, communication and finance, etc. Themes: industrialization, urbanization, informatization, competitiveness, innovation, quality of life, and so on

Source: RGCMS (2010)

Table 1.7 Category of research contents

Basis	Description
Concept research	The formation, development, transformation, and international interaction of modern civilization frontier Innovation, selection, diffusion, and withdrawal of modern civilization factors
Process and behaviors research	Four aspects: the process, results, driving forces, and mode of modernization Four elements: modernization of behavior, structure, institution, and ideas Interaction: interaction between different fields and factors
Research of results	Four results: modernity, characteristics, diversity, and side effect Four structures: geographic structure, international structure (horizontal structure and tiers of countries), demographic structure, and field structure, etc.
Research topics	Theoretical: world frontiers, long-term trend, civilization transformation, international differentiation, etc. Applied: international competition, experience, catching up with advanced level, frontier innovation, etc.
Nature of the research	Basic research: features and rules of world frontiers and its changes, and scientific principles underlying national advance, etc. Applied research: methods and tools to reach and maintain world frontiers, and basic devices for national advance, etc. Policy research: modernization strategies, plans and policies, etc.

Source: RGCMS (2010)

Usually, modernization research can be done in six fields, each involving or incorporating several sectors. The fields and sectors research matrix reflects the cross-disciplinary nature of modernization research.

1.2.1.3 Academic Pattern

Like other sciences, modernization science should establish its own academic norms.

Table 1.8 Matrix of research scale and unit

Unit	Scale		
	Global	National	Regional
World	Modernization at the world level	–	–
Country	Modernization at the national level across the globe	Modernization of a country	–
Region	Modernization at regional level around the globe	Regional modernization of a country	Modernization of a locality

Source: RGCMS (2010)

Table 1.9 Matrix of research object and content

Content		Object		
		Civilization	Economy, society, politics, culture, and human	Environment (natural and international environment)
Element	Behavior	Modernization of behavior,	Modernization of five fields	Ecological modernization, international modernization
	Structure	structure,	Modernization of behavior, structure, institution, and idea in five fields	Modernization of behavior, structure, institution, and idea of ecological and international interaction
	Institution	institution,		
	Idea	and idea		
Aspect	Process	Process, result, dynamics, and model of modernization	Process, result, dynamics, and model of modernization in five fields	Process, result, dynamics, and model of ecological and international modernization
	Result			
	Dynamics			
	Model			

Note: Generally, ecological modernization is the interaction between the modernization of a country and its natural environment (ecological interaction) and the ecologically friendly transformation of the country's modernization; and the international modernization is the interaction between the modernization of a country and its international environment (international interaction)

Source: RGCMS (2010)

(1) Main Steps of Modernization Research

Modernization research can be done through seven steps in general sense (Table 1.11), which can be followed in an orderly, cyclic, overlap, or selective way.

First, to pose problems. Scientific research starts from posing problems, which includes three aspects as follows in general. (1) Recognizing: whether it is a problem; why is it important? (2) Assessing: What is the nature of the problem? Is there any suitable research method? (3) Identifying: the problem that must be and can be solved and that can be the object of research.

Second, conceptualization. Conceptualization means the selection, deliberation, and definition of concepts and the establishment of basic concepts for scientific research. It mainly includes three aspects also. (1) Selection: Choose proper concepts and try to extract a new one. (2) Appraisal: Compare and deliberate concepts. (3) Standardization: Define concepts in a scientific way.

Third, operationalization. Operationalization means to make detailed plans and establish basic procedures for scientific research. It mainly includes plan preparation

Table 1.10 Matrix of fields and sectors on modernization study

Sector	Field						
	Politics	Economy	Society	Culture	Human	Ecological modernization	International modernization
Government	*						
Defense	*						*
Diplomacy	*						*
Legislation	*						
Justice	*						
Agriculture		*				*	
Industry		*				*	
Service		*				*	
Population			*		*	*	*
Health			*		*		
Social security			*				
Energy		*	*			*	
Transportation		*	*			*	
Information		*	*	*			
Trade		*		*			*
Finance		*					
Tourism		*	*	*	*	*	*
Technology		*		*		*	*
Education			*	*	*		
Culture industries				*	*		*
Sports			*	*	*		*
Environment						*	*

Note: * means the overlap between modernization in this field and modernization in a major sector. The international modernization falls into the “transnational” category

Source: RGCMS (2010)

Table 1.11 Seven steps of modernization study

No.	Steps	Content
1	Posing problems	Recognize, assess, and identify problems
2	Conceptualization	Select, appraise, and standardize concepts
3	Operationalization	Prepare plans, select methods, and choose indicators
4	Collecting materials	Collect, sort, and standardize materials by studies, etc.
5	Analyzing objectively	Analyze materials, assess results, and falsifiability test
6	Presenting results	Results statement, theoretical model, statistical tables and diagrams
7	Offering recommendations	Brief comment, academic suggestions, and policy recommendations

Notes: The methods of data analysis are diverse and have different features, such as empirical analysis, interpretive analysis, realist analysis, and coordinate analysis

Source: He (2010a)

and methods and indicators selection. (1) Plan preparation: Make scientific and rational research plans, including the research subject, object, purpose, target, content, principles, schedule, and so on. (2) Methods selection: Choose a scientific and rational research method. (3) Indicator choosing: Select key analysis indicators and parameters to explain and measure the concepts.

Fourth, to collect materials. Material collection is an important job in scientific research, mainly including three steps as follows. (1) Collecting: Acquire reliable materials and data through experiment, observation, and gathering. (2) Sorting: Eliminate unqualified, vague, and redundant materials through primary examination, observation, and assessment. (3) Standardizing: Verify, classify, standardize, and systematize materials and make up the deficiency.

Fifth, analyzing objectively. Objective analysis is a significant part of scientific analysis, consisting of three aspects. (1) Material analysis: unbiased qualitative and quantitative research. (2) Result assessment: result examination (cross-checking, logical check, and value check) and result analysis (correlation analysis, and analysis of theoretical and practical value). (3) Falsifiability test: negative verification of key conclusions, including reverse check, negative check, and marginal check.

Analysis approaches are diverse, including empirical analysis, interpretive analysis, realist analysis, coordinate analysis, and so on. Generally, empirical analysis would identify the causality without any bias; interpretive analysis would explain the significance of phenomena, respect the rules and the interests of the mankind, and reduce and avoid biases; and realist analysis would respect laws and objective conditions. The coordinate analysis will be discussed later.

Sixth, presenting results. Results presentation is an important component of scientific research, mainly including result statement, theoretical model, statistical tables, and diagrams. (1) Result statement: neutral and unbiased result report. (2) Theoretical model: theoretical abstraction or interpretation based on facts. (3) Statistical tables and diagrams: Present theoretical model, facts, or other evidences in a statistical or digital format.

Seventh, offering recommendations. Recommendation is usually the last part of scientific research, which is composed of brief comment, academic suggestions, and policy recommendations. (1) Brief comment: Make objective and brief comment on the method, result, significance, and defects of the research. (2) Academic suggestions: Identify problems to be further studied or needing attention. (3) Policy recommendations: presenting policy implications of the research findings.

(2) Main Requirements for Modernization Research

There are six requirements for modernization research generally (Table 1.12).

First, specifying the purpose. It is crucially important for scientific research to clarify its purpose, meaning, and nature. Generally, the basic research of modernization study mainly has academic purposes, the applied research serves both academic and practical ends, and the policy research is for useful purposes (Table 1.17).

Second, defining the object. Modernization research has myriads of objects to explore. A specific object and related materials should be carefully chosen when the modernization research is conducted. The object, once selected, should be further defined, mainly in terms of time, place, and actor (Table 1.13).

Table 1.12 Six requirements for modernization study

No.	Requirement	Content
1	Specifying the purpose	Making clear the purpose, meaning, and nature of the research
2	Defining the object	Selecting and defining the object, including defining time, place, and the actor
3	Establishing the content	Selecting and defining the research content, focusing on civilization frontier and international division, and catching up with other countries
4	Scientific approaches	Conducting experiment and observation, collecting and sorting materials, and analyzing materials and results through scientific methods
5	Objective and unbiased	Holding an unbiased attitude in selecting the object and the content, collecting materials, and analyzing materials and results
6	Sound citation	Introducing and citing previous literature in an objective, systematic, and comprehensive way

Source: RGCMS (2006)

Table 1.13 Define the research object

Item	Content
1. Time	Time period: a year, several decades, or centuries
2. Place	Geographical boundary: a region, a country, countries in a specific category, or the whole world
3. Actor	Actor: the world, a country, a region, a sector, an enterprise, a household, individuals, etc.

Third, establishing the content. The content of modernization studies is diverse (Table 1.7). After the selection and definition of object of modernization research, research content also needs to be selected and defined.

Fourth, adopting scientific approaches. Scientific research approaches should be adopted, which are embodied in three aspects as follows. (1) Previous research should be objectively treated. Literature related to the research subject and content shall be reviewed, so as to understand studies that have been done, their findings and arguments, as well as deficiencies and thus to avoid repetition. (2) Rational research principles should be adopted. The research principle must be logical, serve the research purpose, and cater to the research object and content. (3) Likewise, reasonable research approaches are also significant. They must be scientific, serve the research purpose, and cater to the research object and content.

Fifth, being objective and unbiased. One needs to be objective in establishing the purpose and selecting the object and content. The research principle and approach should be selected in an unbiased way. Research materials and results should be analyzed and presented objectively. The scientific significance of research finding should be presented as it is, instead of exaggerated or overstated. It is acceptable to make reasonable inferences based on research findings, but preconditions for the inference should be clarified, while undue “amplification” is prohibited.

Sixth, sound citation. Sound citation is the basis for scientists to assess the scientific and academic value of others’ research work and also an honor and credit mechanism recognized by the research community and the society. Without sound

citation, it is hard to tell which part in a modernization research has been actually done by previous researchers and which part is new.

The modernization research should be in conformity with scientific norms and be conducted in a rational, systematic, objective, and unbiased way.

1.2.2 General Methods of Modernization Study

Since modernization science is an interdisciplinary one, modernization research involves multiple disciplines. Country is usually taken as a basic unit in the research, but research can also be extended to other levels such as world and region.

1.2.2.1 Methodologies

Modernization research can be done from different perspectives which may require different methodologies (Table 1.14). From the perspective of science, positive methods can be used in the research to reveal objective facts and basic laws about

Table 1.14 Three methodologies in modernization research

Aspects	Positivism	Interpretivism	Realism
Core ideas	The world is an objective being and can be observed objectively. There are no deep structures that cannot be observed	The world is not an independent being; it is made up of societies or discourses. It is impossible to do an objective analysis	The world is an independent being. Any observation is subject to the influence of theory. There are deep structures that cannot be observed
Purpose of research	Statements of causality and objective facts. Establishment of cause-and-effect relations and explanation of the laws	Statements of correlations and interpretation of significance. Significance and expressions of and motives behind phenomena	Causality and the key role of deep structures that cannot be observed directly in the results
Subject of research	Empirical question about “what is it”	Normative question (significance and belief) about “what should it be”	Realist question about what to do and how to do; separation of phenomena and facts
Research results	Causality, explanation, and forecast models; objective and neutral	Subjective judgment; establishment of belief, ideas, and discourses; development of significance and interpretation	Causality and the influence of interpretation and understanding on the results, structure, and behaviors
Academic value	Scientific value: understanding the world	Humanistic value: interpreting the world	Realist value: discovering and changing the world
Applied disciplines	Natural and social sciences	Social sciences and humanities	Social sciences, policy research, etc.

Note: It is based on the ideas of Marsh and Stocker (2002)

Source: RGCMS (2010)

modernization so as to establish an objective and unbiased cause-and-effect model. From a humanistic perspective, interpretive methods can be adopted to describe the significance of and correlations in modernization so as to develop the discourse and concepts about the phenomenon of modernization. From a policy perspective, realist approaches can be taken to summarize the causality and value orientation in modernization so as to offer a model to explain modernization and relevant policy recommendations. Despite having some mutual criticisms among them, the three methodologies are actually complementary to each other.

(1) Positivism

Positive study is a basic style of natural sciences, but it is also getting increasingly popular in social sciences. As an English proverb *Seek the truth from facts*.

First, modernization phenomena are objective and independent beings.

Second, knowledge about modernization can be acquired through objective observations.

Third, the study is about observing modernization, proposing a hypothesis and testing, and revising the hypothesis.

Fourth, the purpose is to identify the causality and laws in modernization.

Fifth, modernization theory can explain modernization phenomena and make forecast which can be tested.

Sixth, the study addresses questions as to “what is it?” and “why is it?”

(2) Interpretivism

Normative study is a basic style of social sciences, particularly humanities.

First, modernization phenomena are not independent beings but made up of societies or discourses.

Second, it is impossible to make an objective analysis of modernization, and the understanding of modernization will influence its results.

Third, the belief, ideas, or discourses about modernization are studied to explain the relations between belief, ideas, and behaviors.

Fourth, the relations between modernization phenomena are interpreted to find the correlations.

Fifth, the interpretation theory can well explain the significance and expressions of and motives behind modernization.

Sixth, the study addresses questions as to “what should it be?” and “what significance does it take?”

(3) Realism

Realist study is a basic style of social sciences and policy research.

First, modernization phenomena are objective and independent beings.

Second, only part of modernization phenomena and their relations can be observed directly.

Third, facts and phenomena can be separated sometimes. The understanding of modernization affects modern behaviors and structure.

Fourth, the purpose is to identify the causality and laws in modernization.

Fifth, modernization behaviors are usually affected by laws and significance.

Sixth, the study addresses questions as to what to do and how to do.

In the science of modernization, the differences between positive, interpretive, and realist studies are relative, and sometimes, the three approaches are used alternatively or simultaneously. In general, a positive study offers the facts and principles about modernization; an interpretive one offers the significance of and correlations between modernization phenomena; a realist one offers the choices and suggestions about modernization.

Modernization research and theory are also greatly influenced by critical theory and futurology.

1.2.2.2 Interdisciplinary Approaches

There are a variety of methods to do modernization research. A basic principle is that the method should fit the purpose and object of the research. In general terms, modernization refers to world frontiers as well as the behaviors and process to reach the frontiers. Therefore, the two focuses in modernization research are the analysis of world frontiers and that of the process to reach the frontiers where different research models are adopted.

(1) General Measures

Since modernization is an interdisciplinary science, many research methods in natural and social sciences can also be applied in modernization research such as observation, survey, simulation, hypothesis, psychological, statistical, quantitative and qualitative analysis, model, theoretical, comparative, historical, literature, process, and scenario analysis, as well as case study.

There are many types of modernization research where different research methods are adopted (Table 1.15). Specifically, it can be ex post, ex ante, or systematic analysis in terms of the timing of the research, and one-dimensional, cross-disciplinary, or comprehensive studies in terms of the research dimensions. Cross-disciplinary and comprehensive studies are both multidimensional. In addition, different methods are needed for the research about the past, present, and future of modernization.

(2) Frontier Analysis of Modernization

Frontier analysis includes the identification, comparison, and change analysis of global modernization frontiers. By analyzing the characteristics, levels, and changes of world frontiers, we can find out the laws governing the evolution of civilizations and the basic principles about the development of a country.

First, the identification of world frontiers. How to identify world frontiers is a key question in modernization research. Modernization involves the change in every aspect of human civilization, which makes it necessary to ask the following questions. Where are the frontiers in the changes of those different aspects? Where is the general frontier in the evolution of human civilization as a whole?

- The identification of world frontiers in one aspect or by one indicator (Table 1.16).
 - (1) The changes in some aspects can be analyzed on a quantitative basis, and relevant

Table 1.15 Main types of modernization study

No.	Type	Features and methods
1	Ex post analysis	Research done after the occurrence of modernization phenomena, such as the studies of the process and results of modernization
2	Ex ante analysis	Research done before the occurrence of modernization phenomena, such as the studies of the prospects and strategies of modernization
3	Systematic analysis	Cross-disciplinary and systematic research about the entire process of modernization from its origin, innovation, to the end, modernity
4	One-dimensional study	One-dimensional and one-disciplinary research about modernization phenomena
5	Cross-disciplinary study	Two- or multidimensional and cross-disciplinary research about modernization phenomena
6	Comprehensive study	Multidimensional and interdisciplinary research about modernization phenomena
7	Research on the past	Research about the past of modernization including studies about the timing, sections, process, frontiers, and paradigm, as well as literature and historical analysis
8	Research on the present	Research about the present of modernization including hierarchy, section, statistical, and comparative analysis, as well as frontier analysis, social surveys, and case studies
9	Analysis of the future	Research about the future of modernization including regression and trend analysis, linear and nonlinear extrapolation, as well as analysis of approaching objectives and scenarios

statistics are available. The world frontiers of such changes can be identified through international comparison of the statistics. (2) The changes in some aspects can be analyzed on a quantitative basis, but relevant statistics are not available. The world frontiers of such changes can be identified through case studies and comparison between nations in the world. Since it is hard to acquire relevant information and data, such comparison is not easy. (3) The changes in some aspects are hard to be analyzed on a quantitative basis. Identifying the world frontiers of such qualitative changes requires comprehensive analysis including positive and interpretive studies. (4) The changes in some aspects have just occurred so it requires rational analysis and takes time to see whether such changes represent world frontiers.

- The identification of world frontiers in a specific field. It can be done by comparing the key indicators in the field or setting a composite index which includes quantitative and qualitative indicators. Both approaches may give rise to controversy. In a single field, the level and characteristics of developed countries usually represent world frontiers.
- The identification of world frontiers in the development of human civilization as a whole. It can be done by setting a composite index which includes quantitative and qualitative indicators to make assessment, comparison, and judgment. The model and method of the composite index may give rise to controversy. The level and characteristics of developed countries usually represent world frontiers.
- Is there just one frontier or multiple global frontiers? The answers may differ in different fields and aspects. There is only a single frontier in some aspects like

Table 1.16 Identification of world modernization frontiers

No.	Indicators	Frontiers or the methods to identify the frontiers	Indicator examples
Quantitative indicators			
1	Increasing variables	Global maximum value, average value of high-income countries, average value of developed countries	GNI per capita
2	Decreasing variables	Global minimum value, average value of high-income countries, average value of developed countries	Infant mortality rate
3	Transitional variables	Average value of high-income countries, average value of developed countries	Ratio of industrial value-added in GDP
4	Fluctuating variables	There are frontiers to talk about only for some variables (average value of developed countries)	Growth rate of GDP per capita
5	Random variables	There are differences between different nations but usually no world frontiers	Losses caused by natural disasters
6	Regional variables	There are differences between different nations but usually no world frontiers	Water resource per capita
7	Stable variables	There are differences between different nations but, usually, no world frontiers	Land resource per capita
Qualitative indicators			
8	Institutional variables	Case studies are required. Sometimes, institutions of developed countries represent the frontiers, while sometimes, there are diversified frontiers	Welfare system
9	Conceptual variables	Case studies are required. Sometimes, ideas of developed countries represent the frontier, while sometimes, there are diversified frontiers	Cultural concepts
10	Characteristic variables	Case studies are required. Sometimes, characteristics of developed countries represent the frontier, while sometimes, there are diversified frontiers	Educational pattern

Notes: Developed countries refer to the group of some 20 countries categorized as developed nations according to the second modernization index

university education penetration but multiple frontiers in other aspects such as cultural concepts.

- The research reports of OECD contain substantial data about world frontiers.

Second, the comparison between world frontiers. (1) Comparison and analysis should cover the qualitative characteristics, quantitative levels, and categories of world frontiers. (2) Qualitative characteristics: In many cases, the qualitative characteristics of developed countries represent those of world frontiers. (3) Quantitative levels: In many cases, the quantitative levels of developed countries represent those of world frontiers. (4) Categories: single frontier, multiple frontiers, or no frontiers.

Third, changes in world frontiers. (1) Analysis of the changes in world frontiers may include trend and time-series analysis, and the comparison of multiple sections. (2) Quantitative changes in frontiers include regression, trend and time-series analysis, and the comparison of multiple sections. (3) Qualitative changes in frontiers include case study, comparative and interpretive analysis, and the comparison of multiple sections.

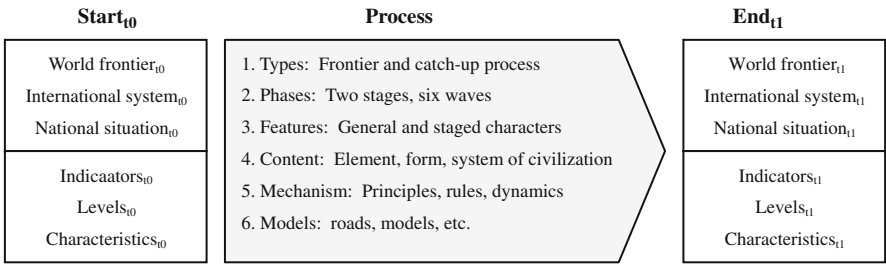


Fig. 1.18 Analysis of the processes of modernization.
Note: The elements of civilization include the behavior, structure, institution, and ideas of civilization

(3) Process Analysis of Modernization

Process analysis covers the types, phases, characteristics, contents, principles, dynamics, roads, models and results concerning the process, and so on (Fig. 1.18), and the analysis of the frontier process and catch-up process is different in some content.

First, the analysis of phases and characteristics. The analysis of the process of modernization is to identify and describe the main phases during the process and the characteristics of each phase. The analysis can be either qualitative or quantitative. The phasing of the process of modernization should be in line with that of the development of human civilization.

In qualitative terms, the phasing of modernization can be either theoretical or practical. Theoretical phasing, widely seen in various modernization theories, is based on the track of frontiers in the process of modernization. Practical phasing refers to the fact different countries have different phasing of the process of modernization. For instance, the second modernization theory suggests that the period between the eighteenth century and the end of the twenty-first century is divided into the two stages: the first modernization and the second modernization. Each stage includes four phases, that is, start phase, development phase, mature phase, and transition phase, and three waves. Such phasing is made based on the frontier track in the process of modernization.

The quantitative phasing of modernization requires the defining of standards. Generally, such phasing can be made according to the quantitative indicators for the frontier track in the process of modernization. For example, the phasing standards for the first and second modernization are set based on the indicators for industrial and employment structures (Tables 1.17 and 1.18).

The qualitative phasing is usually made based on the frontier track and major historical events in the process of modernization. Quantitative phasing is usually made according to the statistical indicators. Every statistical indicator has a value which represents the average level of a country by that indicator, so it reflects the average level of a country. Apparently, the two types of phasing are different in some ways.

To put it simple, qualitative phasing is based on frontier track while quantitative phasing is based on average level. The analysis of the characteristics of the process of modernization is usually qualitative and about theoretical generalization.

Table 1.17 Phasing standards for the first modernization

Phases	Ratio of agriculture value-added in GDP	Agriculture value-added/ industry value-added	Assigned value	Annotation
Transition	<5%	<0.2	4	One standard for the completion of the first modernization is that the ratio of agriculture value-added to GDP takes up less than 15%. It is set based on the 200-year history of economic development of industrialized countries
Mature	<15%, ≥5%	<0.8, ≥0.2	3	
Developing	<30%, ≥15%	<2.0, ≥0.8	2	
Start	<50%, ≥30%	<5.0, ≥2.0	1	
Traditional societies	≥50%	≥5.0	0	
Phases	Ratio of agricultural labor in total labor force	Agricultural labor/ industrial labor	Assigned value	Annotation
Transition	<10%	<0.2	4	One standard for the completion of the first modernization is that ratio of agricultural labor to total labor makes up less than 30%. It is set based on the 200-year history of economic development of industrialized countries
Mature	<30%, ≥10%	<0.8, ≥0.2	3	
Developing	<50%, ≥30%	<2.0, ≥0.8	2	
Start	<80%, ≥50%	<5.0, ≥2.0	1	
Traditional societies	≥80%	≥5.0	0	

Notes: The values of the phases of the first modernization equal the average of the assigned values of the four indicators in the four phases

Source: RGCMS (2010), He (2010a, b)

Table 1.18 Phasing standards for the second modernization

Phases	Ratio of material industries value-added in GDP	Ratio of material industries labor in total labor	Assigned value	Precondition
Mature	<20%	<20%	3	Only countries at the transition phase of the first modernization are eligible for identifying which phase of the second modernization they are in
Developing	<30%, ≥20%	<30%, ≥20%	2	
Start	<40%, ≥30%	<40%, ≥30%	1	
Preparatory	<50%, ≥40%	<50%, ≥40%	0	

Notes: The values of the phases of the second modernization equal the average of the assigned values of the two indicators in the four phases. Material industries refer to agriculture and industry

Source: RGCMS (2010), He (2010a, b)

Second, the analysis of contents and principles. (1) The content analysis can be either positive or interpretive such as time-series, cross-sectional, hierarchy, structural, historical, and qualitative analysis and case study. (2) The analysis of the principles, mechanism, and dynamism in the process of modernization can be kinetic, element, competitiveness, interpretive, model, regression, and random process analysis and case study. (3) The analysis of the path and model of modernization can be case study and comparative analysis. (4) There are close relations between the contents, principles, and results of modernization, particularly between the contents and principles, contents and results. Such correlations can be analyzed.

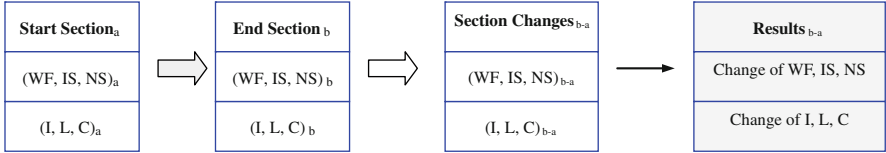


Fig. 1.19 Analysis of the results of modernization.
Notes: WF refers to the world frontier, IS refers to the international system, and NS refers to the national situation. I represents the indicators, L represents the levels, and C represents the characteristics. From the start section_a to the end section_b, the results of modernization mainly include the macrochanges, such as the changes of world frontier, international system, and national situation, and also microchanges, such as the changes of indicators (new/canceled ones), levels of original and new indicators as well as characteristics (new/lost ones). Such results contain modernity, individuality (particularity), diversity and side effect, etc. During the process of modernization, some changes may disappear and thus are not reflected in the results

Third, the analysis of results. The results of modernization process relate closely to the span of the process, or in other words, the start and end sections (analysis sections) (Fig. 1.19). By comparing the world frontier, international system and national situation in the macroperspective and the indicators, levels, and characteristics in the microperspective that modernization takes on at two different historical sections, we can find out the results of modernization produced between the two sections. The comparative analysis of sections can be either quantitative or qualitative. In general terms, the results of modernization are represented as a function of time. So is modernity.

Between the start section_a and the end section_b, the results of modernization = section_b – section_a.

Simplified mathematical expression: $f_{b-a} = f_b - f_a$.
In the expression, f represents the function of the status of modernization and f_{b-a} represents the change of the status. f_b and f_a represent the status of section_b and section_a, respectively.

(4) Analysis or Interpretation of the Modernity

Modernity study is an interdisciplinary one with diversity of the approach. Definitely, modernity is one part of the results of modernization, but there is not yet a consensus on the modernity at all. There are more than 3,800 papers by the “modernity” key word search from 2001 to 2010 in the database of “Web of Science.” The researches can be divided mainly into two categories.

One is by interpretive methods. Some scholars interpret the modernity with individual value or social ideology. This method was widely adopted in the field of culture study and postmodernity study, etc.

The other is by positive methods. Some researchers state the modernity with the collection of the characteristics of modern industrial society based on the historical and objective facts. This method was widely applied in the study of second modernization, *China Modernization Report* and this book.

The former approach is the way of normative study, sometimes the theoretical analysis, and the later is the way of scientific study especially natural science. Both of them are applied to modernization science.

The modernity study and modernization study overlap with each other. In the developed countries, more scholars pay more attention to the modernity study, and it is more relative to the necessity and future of themselves. In the developing countries, more scholars focus more on modernization study especially the process and frontier analysis, which is more necessary for their countries and the policy-making.

(5) Analysis of the Particularity and Diversity

The particularity is the individual features of a single country, which is affected by its history, customs, tradition, environment, relative level, and status, including the individuality of process and result, etc.

The diversity is mainly based on the collection of the particularities of different countries generally. The process diversity and result diversity are related to the aggregates of the particularities of processes and results of different countries separately. The vertical diversity is relative to the gathering of the particularity of country with different level, while the horizontal diversity is almost based on the sum of the particularity of country in the same level, such as the diversity of the developed countries and the developing countries, the diversity of moderately, preliminarily and underdeveloped countries separately.

The diversity of the developed countries is related to the multiple modernities.

1.2.2.3 Challenges

Modernization research is faced with a series of internal and external challenges.

(1) Challenges on Positive Study

Positive research about modernization is faced with many challenges. For example, comparative analysis is a basic method in modernization research. But there are several key questions to address before making such analysis. Who are going to be compared? What is the comparison about and based on? How is the comparison going to be done?

First, if country is taken as a basic research unit, comparison can be done both vertically and horizontally. However, given that countries differ a lot in terms of size, development level, and culture, and that the geographical scope and environment of the same country are different in different historical periods, the comparison of modernity between different countries is often questioned and challenged.

Second, if the world was taken as a research unit, it would be rather hard to do the comparative analysis. The researcher will run into a good number of questions that are difficult to address. Who is the world? Who is going to be compared with the world? What is the comparison about and based on? How is the comparison going to be done? It is relatively easy to do a vertical comparison between the world at present and that in the past. But it is hard to make horizontal comparison because many questions cannot be addressed. For example, who is going to be compared with the world today? How to compare and define the world's development level as a whole?

(2) Challenges on Interpretive Study

Interpretive studies are often seen in modernization research. Such studies are conducted based on the researcher's value judgment which is often challenged by people because it may be subject to subjective bias, social implications, the limit of knowledge, and other negative factors.

Interpretive studies are to find out the essence, significance, characteristics, motive, and belief pertaining to the subject of the research. If the subject is simple, it is easy to do the interpretation. But if the subject is very complicated, it will be completely the other way around.

For instance, world modernization at global level includes the world as a whole, global behavior, structure, institution, and six fields such as economy. Suppose that every aspect has its own characteristics, then how can we interpret the integrated characteristics the world modernization at global level takes on? Do integrated characteristics equal the sum of each aspect's characteristics?

Interpretive modernization is usually qualitative. But without quantitative analysis, the academic value of modernization research will be questioned because qualitative interpretation is usually based on the researcher's value judgment which is faced with challenges in three aspects, namely, the conformity of personal judgment to objective phenomena, the recognition of the academic community, and the acceptance by the general public.

(3) Challenges on Interdisciplinary Science

Modernization research is also challenged as an interdisciplinary science.

First, very few people master interdisciplinary knowledge. Second, interdisciplinary research is usually very difficult to carry out. Third, very few experts can give an objective evaluation of an interdisciplinary science. Fourth, interdisciplinary researchers are usually marginalized in their own original field, without getting due attention. Fifth, people are giving more attention to interdisciplinary sciences, but it is still hard to obtain the funds for interdisciplinary research.

Despite all the difficulties, interdisciplinary sciences have witnessed marked development in recent years. Since 1998, interdisciplinary research and education have received growing attention in American universities. Statistics of the National Center for Education Statistics (NCES) of the United States in 2005 show that the number of university graduates with bachelor's degree in interdisciplinary sciences grew from 7,000 in 1973 to 30,000 in 2005.

1.2.3 Coordinate Analysis of Modernization Study

The science of modernization is a newly emerging discipline, which can and needs to seek for useful tools from the research tool kit of natural and social sciences and establish scientific methodology of its own. The second modernization theory lays out an approach to study and mark the development of modernization by using the "coordinates of modernization," which is called the "coordinate analysis of the modernization research" for short.

1.2.3.1 Three Steps

The coordinate analysis approach of the modernization research mainly includes three steps and six parts (Table 1.19), with the major characteristics as follows: the combination of time-series analysis and cross-sectional analysis, the combination of quantitative analysis and qualitative analysis, modeling, graphical and quantitative representation of the analysis approach and results, and of systematic, empirical, and scientific nature. The three steps and the six parts relate to and support each other and form the continuous and serial-time coordinate graph and cross-sectional distribution chart, so as to mark the development and distribution of modernization in a relatively straightforward and systematic way. The approach can be applied to all the research areas of the modernization science.

(1) Setting Up the Coordinate System of Modernization

As the core component of the coordinate analysis, the coordinate system of modernization includes the timetable, the periodic table, the coordinates, and the road map of civilization and modernization. Here we are going to discuss the coordinates of civilization and modernization, leaving the rest for Chap. 3.

First, the coordinates of civilization and modernization. It consists of the horizontal and vertical coordinates. The former may refer to the historical time and the “civilization time” while the latter may refer to the level of civilization, modernization, and modernization indicators. The “civilization time” is a timescale marked according to the “frontier track” of human civilization (Table 1.20).

All the countries in the world use the same historical time; however, during the same historical period, the “civilization time” in different countries may vary. The historical time is like the biological age of human body, while the civilization time is the physiological age. For those countries which are advanced in terms of human civilization, the civilization time might be in coincidence with the historical time, but for those which are underdeveloped in terms of human civilization, their civilization time is not in coincidence with the historical time. For example, in 2000, the United States was in the stage of knowledge civilization while some African countries were still in the stage of agricultural civilization.

Table 1.19 Coordinate analysis approach of the modernization study

No.	Main steps	Six parts	Notes
1	Setting up the coordinates	Coordinate system of modernization	Defining the horizontal and vertical coordinates
2	Variable analysis	Paradigm analysis, quantitative analysis, time-series analysis, and cross-sectional analysis	Analyzing the variables of modernization
3	Result statement	Coordinate map and road map of modernization	Marking the analysis results on the coordinates

Source: RGCMS (2006)

Table 1.20 Civilization time and historical time

Civilization time	Historical time (approx.)	Civilization time	Historical time (approx.)
Primitive culture	2.5 million years ago to 3500 BC	Industrial civilization	1763–1970
Start period	2.5 million years ago to 200 thousand years ago	Start period	1770–1870
Developing period	200,000 to 40,000 years ago	Developing period	1870–1913
Mature period	40,000 to 10,000 years ago	Mature period	1914–1945
Transition period	10,000 years ago to 3500 BC	Transition period	1946–1970
Agricultural civilization	3500 BC–AD 1763	Knowledge civilization	1970–2100
Start period	3500 BC–500 BC	Start period age	1970–1992
Developing period	500 BC–AD 618	Developing period	1992–2020
Mature period	618–1500	Mature period	2020–2050
Transition period	1500–1763	Transition period	2050–approx. 2100

Note: Time period refers to the physical time, while the “civilization time” refers to a timescale marked according to the “frontier track” of human civilization

Source: He (1999)

Table 1.21 The coordinate system of the modernization study

Item	The basic coordinate system	The coordinate system of specific fields
The vertical coordinate	The level of civilization or modernization	The level of economic, social, political, and cultural modernization and the level of a certain indicator
The horizontal coordinate	The historical time and the civilization time	The historical time, the civilization time, the time of economic development, the time of social development, and the productivity

Note: The time of economic development refers to a timescale marked according to the “frontier track” of the world economic development. The other similar terms can be analogized likewise

Source: RGCMS (2010)

Second, the coordinate types. The coordinates of civilization and modernization can be divided into several categories: basic coordinates, coordinates of different stages, levels, fields, sectors, themes, and single indicators (Table 1.21). They are all important part of the coordinate system of modernization.

(2) The Variable Analysis in the Coordinate Analysis

First, the paradigm analysis, which is a qualitative analysis approach. The modernization paradigms include fundamental paradigms (the modernization and the forms of civilization, etc.) and the paradigms of all the fields of human civilization (such as the economic formation, the social formation, the political formation, and the cultural formation). The result of the analysis of modernity, the formation of civilization, and the paradigms of all areas of human civilization can serve as the basic variable of the coordinate system of modernization.

Second, the quantitative assessment, which includes the general assessment and the measure of different stages, levels, fields, sections, themes, and single indicators. Sometimes the quantitative and the qualitative evaluation can be combined together to form a comprehensive one.

Third, the time-series analysis includes the analysis of civilization, modernity, different stages, levels, fields, sector, themes, and single indicators.

Fourth, the cross-sectional analysis includes the analysis of civilization, modernity, different stages, levels, fields, sections, themes, and single indicators.

(3) Result Statement of the Coordinate Analysis

If the results of the assessment of modernization process, the time-series analysis, the cross-sectional analysis, the paradigm analysis, and the general process analysis are marked in the coordinates of modernization, then we will have the coordinate graph and the road map of modernization. The general graphs and the decomposition graphs of different stages, levels, fields, sections, themes, and indicators form a system of coordinate graph and road map of modernization, to present a comprehensive view of the development and distribution of modernization.

1.2.3.2 Four Approaches

(1) The Paradigm Analysis

Generally, the modernization research consists of not only the analysis of single elements but also the analysis of overall picture, to avoid missing the forest for the trees. The overall analysis of the modernization research is to analyze the overall change of modernization, but so far, there is no general way of doing it. One alternative is to analyze the change of modernization “paradigm” in the light of the concept of “paradigm” of the philosophy of science and form the paradigm analysis of modernization research. It is an approach with the combination of positivism and interpretivism.

The paradigm analysis of modernization research can be used to analyze not only the paradigm shift of human civilization but also that of economic, social, political, cultural, and ecological modernization. The paradigm analysis of human civilization is used here as an example to illustrate its analysis approach. The paradigm of human civilization³ is based on the basic types of human civilization (civilization paradigm) to analyze its development mode (Example 1.6) and establish an overall analysis framework of the development of human civilization.

³ The approach of paradigm analysis of human civilization is controversial because simply attributing the development mode of human civilization to the evolution and shift of some basic “civilization paradigms” is considered to oversimplify the problem, and there is yet no universal understanding of “civilization paradigm.” However, the paradigm analysis can be still used as a valuable analysis approach in the modernization research.

Example 1.6 The Development Mode of Human Civilization

The human civilization has a history of about 5,500 years, yet without a unified definition of civilization. From the practicality perspective, civilization refers to all the achievements of human development since about 3500 BC. The human achievements can be measured by a series of indicators, with the development level of one indicator showing that of one civilization element and the comprehensive development level of all indicators showing that of civilization. One question has to be answered before the research on the development mode of human civilization begins: Is the human civilization a whole or a set? There is yet no universal answer to this question. Therefore, we can discuss it in two ways.

1. The Human Civilization as a Whole

Suppose that the human civilization is an organic whole. The research on the overall development of human civilization requires the measurement of the general development level of civilization. But there is no universal way of measuring it. In 2006, with over 6.5 billion world population and over 190 countries, there was great lack of balance in the development of different countries: Some had entered into the stage of knowledge civilization, some were still in the stage of industrial civilization or agricultural civilization, and the primitive culture was still pervasive in a few ethnic tribes. So, which country is to represent the overall development level of the human civilization?

A group of indicators are used in *China's Modernization Report* to represent the "overall development level of human civilization," which are the average level, the advanced level, and the bottom level of the development of human civilization. The average level is represented by "the world average level," the advanced level by "the average level of developed countries," and the bottom level by "the average level of underdeveloped countries" (Research Group for China Modernization Strategies et al. 2010).

The approach of analyzing the overall development of human civilization by comparing the changes of "the overall development level of human civilization" might be subject to debates, because there is no universally recognized way of measuring "the overall development level of human civilization." Therefore, it is controversial to adopt a group of indicators to represent the level.

2. The Human Civilization as a Set

Suppose that the human civilization is a set of national and ethnic civilizations, then the research on the development of the civilization set requires the analysis of the structure and changes of the set. Though the civilization set consists of different civilizations, there is no universal rule of categorizing civilizations yet. For instance, each language has its own civilization, so does each people, each country, each region, each religion, and also each kind of social productivity. According to different kinds of social productivity, civilizations can be categorized as the primitive culture, the agrarian civilization, the industrial civilization, and the knowledge civilization (He 1999).

The structure of human civilization system (civilization set)		
Basis of civilization category	Examples of different types of civilizations	Annotation
<i>World civilization</i>	Relatively speaking, it normally refers to the civilization formation with “the world as the unit of analysis”	
According to different levels of civilization	The advanced level, middle level, and the bottom level of the development of the human civilization	It changes any time
According to different levels of productivity	The primitive culture, the agricultural civilization, the industrial civilization, and the knowledge civilization	In the order of time sequence
According to different historical periods	The ancient civilization, the classic civilization, the Middle-Ages civilization, the near modern civilization, and the modern civilization	In the order of time sequence
According to the characteristics of civilization	The terrestrial civilization, the maritime civilization, and the cosmic civilization	In the order of time sequence
According to the natures of civilization	The material civilization, the spiritual civilization, and the ecological civilization	It changes any time
<i>Regional and national civilization</i>	Relatively speaking, it normally refers to the civilization formation with “the nonworld as the unit of analysis”	
According to different regions	The Asian civilization, the African civilization, the American civilization, and the European civilization	With multiple categories
According to different countries	Chinese civilization, Indian civilization, Egyptian civilization, American civilization, and German civilization The civilization of developed countries and the civilization of underdeveloped countries Countries of agricultural civilization, countries of industrial civilization, and countries of knowledge civilization	Categorized according to different levels and characteristics of countries
According to different ethnic groups	Chinese civilization, Japanese civilization, Arabic civilization, Mexican civilization, and Spanish civilization	It may be cross-national
According to different religion	Buddhist civilization, Taoist civilization, Hindu civilization, and Christian civilization	It may be cross-national
According to different languages	Chinese civilization, Arabic civilization, English civilization, French civilization, and Russian civilization	It may be cross-national
<p><i>Note:</i> The structural change of the civilization system includes the changes of type structure, proportion structure, level structure, and the structure characteristics</p> <p><i>Source:</i> RGCMS (2010)</p>		
(continued)		

The structural change of the human civilization set is a form of representing the civilization development. The mode of evolution and shift of civilization types of the set may represent the development mode of human civilization. With various types of human civilization, the structure of “civilization set” becomes very complex.

If the research focuses on the “subset of national civilizations” inside the “civilization set,” it will be simplified, such as, using the evolution and shift of national civilization types (the unit of the research) to reflect the development mode of human civilization.

Furthermore, if the research narrows down to the “civilization types of developed countries” (types representing the world leading productivity) inside the “subset of national civilization,” then the focus will be shifted to the research of “the advanced level of human civilization,” that is, to study the changes of “the advanced level of human civilization” by analyzing the evolution and shift of “civilization types of developed countries” in different periods. Such changes, to some extent, indicate the development trend of the human civilization.

As a way of studying the development mode of human civilization, it is simple and easy, but it also has its own weakness. For example, using the national civilization as the unit to study the development of human civilization cannot show the changes of the overall development level and international gap of human civilization, for it uses the national civilization instead of the human civilization as the unit and focuses on the advanced civilization instead of the general civilization. However, without any other more reasonable approaches, this one is still of significance.

First, the basic concept of paradigm. The philosopher of science, Kuhn, proposes the concept of “paradigm” in his book *The Structure of Scientific Revolution*. According to him, the development mode of mature science can be represented as “Paradigm I–Scientific Revolution–Paradigm II.” To put it in a simple way, the paradigm refers to the examples universally recognized by all the communities of science, including theorems, theories, and practices. In the history of scientific development, one paradigm represents one common science (which is mature), and the shift from one paradigm to another one represents the Scientific Revolution. In the field of science philosophy, though there are still some debates over it, the paradigm and Scientific Revolution theory is regarded as a powerful theory to explain the scientific advancement.

Second, the basic types of human civilizations. There are different ways of categorizing human civilizations (Table 1.22). They can be categorized into four types according to different levels of social productivity: the primitive culture, the agricultural civilization, the industrial civilization, and the knowledge civilization.

Third, the paradigm analysis of human civilization. According to Kuhn’s “paradigm” concept, the “type of civilization” which is closely related to the distinct characteristics of economic, social, political, cultural, and environmental management and individual behaviors can be regarded as a kind of “civilization paradigm” (Table 1.23). Based on this assumption, the development of civilization can be

Table 1.22 Types of civilization and society

Ways of categorization	Examples of types of society	Examples of types of civilization
Dividing into three types	Traditional society, modern society, postmodern society	Traditional civilization, modern civilization, postmodern civilization
Dividing into four types	Primitive society, agricultural society, industrial society, knowledge society	Primitive culture, agricultural civilization, industrial civilization, knowledge civilization
	Primitive society, agricultural society, industrial society, information society	Primitive culture, agricultural civilization, industrial civilization, information civilization
	Primitive society, agricultural society, industrial society, ecological society	Primitive culture, agricultural civilization, industrial civilization, ecological civilization
Dividing into five types	Primitive society, slave society, feudal society, capitalist society, socialist society	Primitive culture, slave civilization, feudal civilization, capitalist civilization, socialist civilization
Dividing into six types	Hunting and gathering society, gardening society, nomadic society, agrarian society, industrial society, postindustrial society	Hunting and gathering culture, gardening culture, nomadic civilization, agrarian civilization, industrial civilization, postindustrial civilization

Note: The information society and the ecological society are two components of the knowledge society; likewise, the information civilization and the ecological civilization are two components of knowledge civilization

Source: RGCMS (2010)

Table 1.23 Civilization paradigms and their representative characteristics

Item	Primitive culture	Agricultural civilization	Industrial civilization	Knowledge civilization
Historical period	From the birth of human beings to 3500 BC	From 3500 BC to AD 1763	From 1763 to 1970	From 1970 to approx. 2100
Economy	Hunting and gathering	Agricultural economy	Industrial economy	Knowledge economy
Society	Primitive society	Agricultural society	Industrial society	Knowledge society
Politics	Primitive democracy	Autocracy	Democracy	Pluralism of politics
Culture	Primitive culture	Agricultural culture	Industrial culture	Networking culture
Individual	Tribal lifestyle	Rural lifestyle	Urban lifestyle	Cyberspace lifestyle
Environmental characteristics	Worship of nature	Adaptation to nature	Conquering nature	Win-win game for man and nature
	Tribal interaction	International relationship, etc.	International war, etc.	International dependency, etc.

Note: The four civilization paradigms listed in this table represent only one way of categorizing civilization paradigms

Source: RGCMS (2010)

represented as “civilization paradigm I–civilization revolution (civilization transformation)–civilization paradigm II,” or “civilization type I–civilization revolution (civilization transformation)–civilization type II.” Hence, the development of civilization is represented by the evolution and shift of civilization paradigm in an abstract way, and modernization by the formation and transformation of modern civilization paradigm. In other words, we can use the civilization paradigm and paradigm shift as the framework for the discussion of the qualitative changes of the characteristics of civilization and modernization.

The civilization paradigm is a three-dimensional concept. (1) It is limited to a certain historical period. Every fundamental civilization paradigm corresponds to a certain civilization period. The time of civilization is marked according to the “frontier track” of human civilization with the state as the unit. (2) It is structured. Every civilization paradigm has its own basic structure, such as the structure of knowledge, technology, production, institution, or conception. (3) It is clearly characterized. Every civilization paradigm has its own basic characteristics, such as economic, social, political, cultural, individual, and environmental characteristics.

The categories of and relationship between civilization paradigm and civilization form. As far as the human civilization is concerned, its paradigm can be divided into the fundamental paradigm and the transitional one and its form, the fundamental form, and the transitional one. As to the national civilization, its paradigm can be divided into the main paradigm and the subparadigm and its form, the main form and the subform.

The fundamental paradigm of human civilization. It refers to the relatively mature and stable form of national civilization which represented the highest level of social productivity in the world in its own historical period. From the birth of human beings to the end of the twenty-first century, the human civilization has gone through four basic forms, which are the primitive culture (precivilization), the agricultural civilization, the industrial civilization, and the knowledge civilization. There are essentially different from each other in terms of the economic, social, political, cultural, environmental, and individual characteristics.

The transitional paradigm of human civilization. It refers to the transitional civilization form existing between two kinds of fundamental civilization forms. Since the formation of a new fundamental civilization form cannot take place overnight and has to go through several phases and it also takes a long time for one fundamental civilization form to transform into another fundamental form, therefore, it is implied that besides the fundamental civilization form, there are also some transitional forms. For example, the garden culture and the nomadic culture in the late primitive cultural period, the nomadic civilization and mixed civilization of hunting and farming in the early agricultural civilization period, the half agricultural and half industrial civilization in the early industrial civilization, and the half industrial and half knowledge civilization, ecological civilization, information civilization, and networking civilization in the early knowledge civilization.

The main paradigm (civilization) of the national or ethnic civilization. It is a relative concept, mainly referring to the civilization form corresponding to the average production capacity of a country/people. It can be some kind of fundamental civilization form or transitional civilization form, such as the primitive culture,

the agricultural civilization, the industrial civilization, the knowledge civilization, or some transitional form.

The subparadigm (subcivilization) of the national or ethnic civilization. It is a relative concept, mainly referring to the civilization form which coexists with the main civilization form inside a country and whose social productivity is greatly different from that of the main civilization form, or whose characteristics in the six fields such as economy are greatly different from those of the main civilization form.

Generally, the development of human civilizations does not synchronize and the domestic development is not balanced either. When a country is dominated by a main civilization form, there may exist other civilization forms which are inferior or superior to the main civilization form in terms of social productivity. Because of their relative small size, they are called the subcivilization form. The main and the subcivilization forms are relative, not absolute, and one form can transform into the other.

(2) The Quantitative Assessment

Modernization is a kind of civilization change, including the qualitative change and quantitative change. The latter can be evaluated quantitatively. For example, *China Modernization Report* proposes a batch of quantitative assess models to be applied in the modernization process, including approaches of the first modernization, the second modernization, the comprehensive modernization, the local modernization, the economic modernization, the social modernization, the modernization of cultural life, the ecological modernization, and the international modernization; it also completes the quantitative assessment of the modernization of 131 countries since 1950.

(3) The Time-Series Analysis

The time-series analysis of the modernization research is an important component of the coordinate analysis of modernization. It aims to reveal the long-term trend and law of change of modernization by analyzing and comparing the data, characteristics, materials, and variations of the time series of modernization. It is mainly practiced in the studies of the historical development of modernization and can be used as a kind of trend analysis.

First, selecting the indicators, generally the key indicators for the analysis. The selection can be made from the following three aspects: the comprehensive indicators of modernization; the modernization of behavior, structure, institution, and ideas; and the modernization in six fields such as economy. The indicators of behavior and structure are mostly quantitative while those of institution and ideas are mostly qualitative indicators.

Second, selecting sample countries. Currently, there are more than 190 countries in the world. If possible, the time-series analysis can be conducted for every country; otherwise, a number of countries can be selected for the time-series analysis according to the purpose of the studies.

Third, selecting the time term, generally with the time span of about 300 years (from 1700 to present).

Fourth, collecting the time-series data and materials of the indicators. Generally, for quantitative indicators, statistical data of authorities and related data of well-known academic institutes are used, while for qualitative indicators, relatively scientific and objective research materials should be used.

Fifth, systematically analyzing the variation and long-term trend of the quantitative indicators of modernization.

Sixth, systematically analyzing the long-term trend and characteristics of the qualitative indicators of modernization.

(4) The Cross-Sectional Analysis

The cross-sectional analysis of modernization is an important component of the coordinate analysis of modernization. It aims to reveal or illustrate the structural characteristics and pattern of modernization by analyzing and comparing the data, characteristics, materials, and changes of different time sections. The cross-sectional analysis is mainly used in the studies of the status quo and the historical development of modernization with three major functions: (1) analyzing and illustrating the characteristics of a section of modernization, including the structure, level, and nature; (2) revealing and summarizing the development trend and pattern of modernization; and (3) cross-examining the result of time-series analysis.

There is an assumption behind the cross-sectional analysis. The development of human civilization does not synchronize. The civilization structure of a certain historical section can be regarded as the “historical representation” of the process of human civilization and it transforms the “time sequence structure” of human civilization into the “spatial structure.” It is similar to the phenomenon that the embryonic development of animals is the representation of their evolution process. Of course, this kind of representation is not a repetition; it might leave out some information. The characteristics and laws of the human civilization and modernization can be revealed through the cross-sectional analysis.

Generally, the result of the cross-sectional analysis and that of the time-series analysis can cross-check each other. If the two results are in line with each other, then they are reliable; if they are in conflict with each other, then in-depth thematic studies are needed.

First, selecting the variables. Key indicators are selected from three aspects which is similar to the time-series analysis.

Second, selecting the sample countries and dividing them into groups. The universal cross-sectional analysis of modernization research may cover all the countries in the world (countries whose data is available). For the convenience of representing the sectional characteristics, the countries can be divided into groups to calculate the eigenvalue of each group.

The countries can be categorized according to their level of modernization and civilization as well as that of economic development. In *China Modernization Report*, the countries are divided into nine groups according to their GNI per capita, which of four groups are higher than the world average GNI per capita while which of the rest groups are lower than the world average.

Third, selecting the section according to the purpose and needs of the studies. There are eight sections chosen in *China Modernization Report*: the year 2001, 1980, 1960, 1900, 1870, 1820, 1750, and 1700.

Fourth, collecting the sectional data and materials of indicators. Generally, for quantitative indicators, the statistical data of authorities and related data of well-known academic institutes are used, while for qualitative indicators, relatively scientific and objective research materials should be used.

Fifth, for each group of countries, the “eigenvalue” of a certain variable needs to be calculated for the quantitative analysis method. There are mainly three ways of calculation: the median method, the method of arithmetical average, and the regression analysis. The second one—the method of arithmetical average is adopted in *China Modernization Report*.

Sixth, the systematic analysis of one single section mainly covers the characteristics of the structure, level, and nature of the section, such as the sectional characteristic relationship and statistical relationship between the national economic level and the modernization variable, and the sectional characteristics of institution and conception. The analysis of sectional characteristics can be qualitative, quantitative, or comprehensive.

Seventh, the comparative analysis of two or more sections, including the comparison of structures, levels, characteristics, and natures. And the change rate of the indicators can also be calculated.

1.2.3.3 Variables

Variables or indicators should be selected appropriately for the modernization research.

(1) The Principle of Selecting Variables

Since the subject of the modernization science is very complex, it is impossible to analyze all the aspects and the whole process in one single research. The more reasonable and efficient way is to select a limited number of key variables for analysis. The selection should be made in consideration of the following three factors: The variable should be of academic or policy significance; it should be easy to be compared and analyzed internationally; the data and materials are available and continuous (OECD 2001).

First, policy related and of practical value. (1) Key indicators reflecting the level, structure, or characteristics of modernization. (2) Key indicators reflecting human behaviors. (3) Simple and straightforward, easy to be expressed, able to show temporal trend. (4) Laying the foundation for international comparison, internationally comparable. (5) Reflecting the development issues at the national or regional level. (6) Having marginal or quotation value, and users can make comments on its significance (OECD 2001).

Second, easy to be analyzed. (1) With the solid theoretical foundation of science and technology. (2) With the international agreement on the legitimacy of international standards and indicators. (3) Related to the economic model, forecasting model, and statistical information system (OECD 2001).

Third, measurable. (1) The data is available and at reasonable costs. (2) With enough documents (data records) and trustworthy data. (3) With reliable data which is updated regularly (OECD 2001).

(2) The Nature of Variables

The variables of the modernization research include quantitative and qualitative variables, universal and individual indicators (Table 1.24). Sometimes, by means of social survey, qualitative variables can transform into quantitative variables. For example, the world values survey studies the change of world values by analyzing the result of the questionnaire survey. Generally, conception variation is a qualitative variable.

Table 1.24 Main types of variables in the modernization study

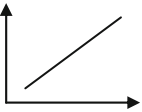
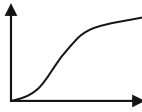
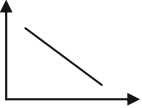
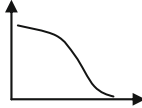
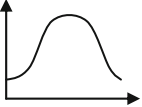
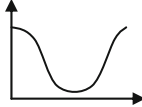
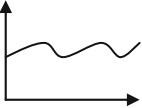
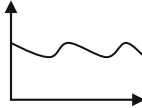


Type	Explanation	Example
Quantitative		
Comprehensive	The comprehensive indicator is the result of the model calculation of several single-item indicators	Human development index
Aggregate	The value of the indicator will reflect the aggregate	Population and GDP
Per capita	The value of the indicator will reflect the per capital amount	GDP per capita
Structure	The value of the indicator will reflect the structural proportion	The proportion of agricultural labor
Efficiency	The value of the indicator will reflect the output of every unit	Productivity
Growth rate	The value of the indicator will reflect the yearly variation rate	The growth rate of GDP per capita
Frontier	The value of the indicator will reflect the advanced level of the world	GNI per capita of developed countries
Average	The value of the indicator will reflect the world average level	The world average of GNI per capita
Bottom	The value of the indicator will reflect the bottom level of the world	GNI per capita of underdeveloped countries
Gap	The value of the indicator will reflect the international gap	The largest gap of GDP per capita
Qualitative		
Institution	Characteristics and variation of institutions	The pension system
Conception	Characteristics and variation of conceptions	The conception of environment protection
Two types		
Universal	Universal indicators related to the common of modernization	GNI per capita
Individual	Individual indicators related to the diversity of modernization	Water resource per capita

Source: RGCMS (2010)

(3) Types of Variables

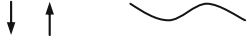
Based on their varying long-term trends and variation characteristics, the variables in the modernization research can be divided into seven categories (Table 1.25). (1) The increasing variable: As time goes by, the value of some variables will increase

Table 1.25 The categorization of the trends of quantitative variables in the modernization study (based on the long-term trend and variation characteristics)

Type	Long-term trend and variation characteristics	Example	Variation mode	
Increasing variable	The value is open and increasing for a long term. It will fluctuate within the short term and is related to the national level	Income per capita		
	The value is of limits and increasing for a long term. It will fluctuate within the short term and is related to the national conditions	The literacy rate of adults		
Decreasing variable	The value is open and decreasing for a long term. It will fluctuate within the short term and is related to the national level	Mortality rate		
	The value is decreasing for a long term and approaching toward the limit. It will fluctuate within the short term and is related to the national level	The proportion of agriculture		
Transitional variable	Increasing and then decreasing It is related to the national level	The proportion of industry		
	Decreasing and then increasing It is related to the national level	Labor safety		
Fluctuating variable	It will fluctuate for a long term with a stable trend. It is related to the national level and conditions	Unemployment rate		
	It will fluctuate in cycles with a stable trend. It is related to the nature of variables	The growth rate of GDP		
Random variable	It happens occasionally and changes randomly. It is related to the national level and conditions	Scientific discoveries and natural disasters		

(continued)

Table 1.25 (continued)

Type	Long-term trend and variation characteristics	Example	Variation mode
Regional variable	The global trend varies greatly in different regions and countries and takes various kinds of forms such as increasing and decreasing	Mineral resources	
Stable variable	The variable whose value is relatively stable	Land resources	

Source: RGCMS (2006, 2010)

and fluctuate within a short term. The value of some variables is open while that of other variables is of limits. (2) The decreasing variable: As time goes by, the value of some variables will decrease and fluctuate within a short term. The value of some variables is of limits while that of other variables is open. (3) The transitional variable: The value of some variables will go through two stages of increasing and then decreasing (or decreasing and then increasing). (4) The long-term fluctuating variable: Some variables will fluctuate within a certain range in the long term, whose variation trend is stable, without obvious movement direction. (5) The random variable: The variation of some variables is random, without distinct trend. (6) The regional variable: For the variation trend of some variables, there are obvious regional differences and multiple forms, without a unified trend. (7) The stable variable: Some variables of some countries change to a limited extent or hardly change, such as the land resources.

If some of the increasing and decreasing variables reach or are close to the saturation number (reach or are close to its limits), then there will be the eighth variable: the saturation number variable. The saturation number variable indicates an ever narrowing international gap and ultimately the indicators of different countries will approach to the limits. Therefore, it is inappropriate to use it as one of the indicators of international comparison.

Obviously, the fluctuating and random variables are less internationally comparable than the increasing and decreasing variables. And the transitional, regional, and saturation number variables are of more policy significance.

Summary

Modernization is an objective phenomenon since about eighteenth century in the world, the modernization science is a newly emerging interdisciplinary one which deals with the modernization phenomenon, and the modernization study is an interdisciplinary or multidisciplinary one. The word modernization first appeared in the eighteenth century (1748–1770). It was commonly used between the eighteenth and the nineteenth centuries and gradually became an academic term in the twentieth century. The modernization science came into being in the twenty-first century.

What's Modernization?

There is no unified definition for modernization, which can be interpreted in mainly three ways.

First, the word modernization has two basic meanings: For one thing, it is an action—an action and process to be modern and adapt to the modern needs (the action and process of realizing modernization); for another, it is a state—a state which has modern features and meets the modern needs (the modernization state). Modern features refer to the new features and changes (normally progressive changes) since about AD 1500

We have the verb “modernize,” the noun “modernization,” and the adjective “modernized.” To put it in a popular way, the modernized refers to the newest, the best, and the most advanced.

Second, the theoretical meaning of modernization. It refers to the definition of modernization in different modernization theories. And different theories have different explanations, as well as sociologists and historians have different thoughts.

Third, the policy meaning of modernization. It refers to the practical application of the modernization theory, and different theories have different policy implication in different nations and stages. From the perspective of national level in policy sphere, modernization refers to the world's advance level at present and the process of reaching or maintaining this advanced level.

Generally, modernization consists of about six layers of theoretical meaning according to the second modernization theory.

First, modernization is a change of civilization, a frontier change of human civilization since the Industrial Revolution in the eighteenth century, including the formation, development, transformation and international interaction of modern civilization, and the innovation, selection, dissemination and withdrawal of civilization elements.

Second, modernization is the international competition to catch up with, reach, and maintain the world's advanced level since the eighteenth century; those countries which reach and maintain the world's advanced level are advanced countries while the rest are developing countries. The two kinds of countries can change their status, and the division is not fixed.

Third, modernization is the world frontier of human civilization since the eighteenth century.

Fourth, modernization is the action to reach or keep the world frontier of human civilization since the eighteenth century.

Fifth, modernization is the historical process to reach or keep the world frontier of human civilization since the eighteenth century. From the eighteenth to the twentieth centuries, the process of modernization can be divided into two stages: the first modernization and the second modernization, with the former characterized by industrialization, urbanization, and democratization and the latter by knowledge-based, information intensive, and greening. The process of modernization can also be divided into two categories: the frontier process and that of catch up.

Sixth, modernization is a transformation of civilization. The first modernization realized the transformation from agricultural to industrial civilization while the second modernization means the transformation from industrial to knowledge civilization and from material to ecological civilization.

The connotation of modernization: Modernization is the civilization change and international competition since the Industrial Revolution in the eighteenth century, and includes the frontier process of the formation, development, transformation, and international interaction of modern civilization; the compound process of the alternative occurring of innovation, selection, dissemination, and withdrawal of civilization elements; and the international competition and international differentiation to catch up with, reach, and maintain the world's advanced level. The countries that reached and kept the world's advanced level are advanced ones while others are not; two kinds of countries can change the status of each other in some possibility.

The denotation of modernization: Modernization happens in different periods, at different levels, in different fields, sectors, and aspects, covering the modern changes of behavior, content, structure, organization, institution, and ideas of the civilization.

The duality of modernization: For one thing, seen from the perspective of civilization change, every country will progress and has the chance to succeed one after another; for another, seen from the perspective of international competition, only a few countries are able to reach and maintain the world's advanced level. In the past 300 years, the number of advanced countries accounted for less than 20% of the total of all the countries in the world while that of developing countries exceeded 80%. In the past 50 years, about 5% of the developing countries have been upgraded to advanced countries while about 10% of the advanced countries have been downgraded to developing countries.

What's Modernization Science?

Modernization science is about the modernization phenomenon, with roughly three meanings:

First, the modernization science is the knowledge system concerning the facts, features, and principles of the modernization phenomenon.

Second, the modernization science is the scientific research activity studying the modernization phenomenon.

Third, the modernization science is the rational thought and method applied to the modernization research.

Generally, the modernization science is a knowledge system and scientific activity concerning the modernization phenomenon.

Figuratively, the modernization science or modernizations is an interdisciplinary science that deals with modernization phenomenon including the world frontier and national advancement since the eighteenth century, which involves the frontier change of modern civilization and international competition, the principles and methods of national advance.

Structure of Modernization Science

The modernization science includes the modernization knowledge and modernization studies. The modernization knowledge includes all kinds of theories and experience concerning modernization, and the modernization studies involve the research activities and methods of modernization science. The knowledge acquired from modernization research does not belong to the modernization science before it is tested and systematized. The modernization studies can be classified into the basic, applied, and development research (policy research). The modernization theories include the basic, applied, and other relevant theories.

Normally, the modernization science consists of seven parts: the general theory (the core theory), the history of modernization, stage-specific modernization, level-specific modernization, field-specific modernization, sector-specific modernization, and modernization policies.

Characteristics of Modernization Science

The modernization science is a new member of the big family of sciences.

The modernization science is not only a cross-disciplinary, applied science but also an integrated science.

The modernization science does not only cross with other sciences but also involves the integrated application of them.

So far, there have been 16 key features of modernization science, such as being cross-disciplinary, highly integrated, large-scaled, and strategically grand.

If the development study is a science about developing countries, then the modernization science is a science about national advancement. Modernization science focuses on how the advanced countries stay advanced, and how the developing countries become advanced, and explains the world frontier of human civilization, the process to reach it, and the principles and methods of national advance.

Paradigm of the Modernization Study

Purpose: to reveal the law of change in the frontiers of modern civilization and the law of national advance, explain and provide approaches to reach the world frontier and realize national prosperity, and satisfy people's curiosity for modernization.

Object: the phenomenon of modernization. The science of modernization focuses on and mainly studies the world frontiers of human civilization and the process and behavior needed to reach the frontier since the eighteenth century and the phenomena of national advance and international differentiation.

Content: the meaning, characteristics, and law of modernization, the principles and approaches for national advance; and so on. It normally covers the process, result, driving force and mode of modernization and the variation of behaviors, structures, institutions and ideas at the frontier of civilization.

Steps: There are seven steps: posing questions, conceptualizing, operationalization, collecting materials, analyzing objectively, presenting results, and offering recommendations, which can be followed in an orderly, cyclic, cross-cutting, or selective way.

Requirements: specifying the purpose, defining the object and the content, adopting scientific approaches, being objective and unbiased, and making complete citations.

General Approaches of the Modernization Study

The methodology of the modernization research: positivism, interpretivism, and realism. Generally, positive studies focus on the facts and principles of the modernization phenomenon, the interpretive studies focus on the meaning of and relationship between phenomena of modernization, while the realist studies provide the choice and suggestions of the modernization phenomenon. Criticism and futurism have great influence upon the studies.

Research approaches of natural and social sciences can be selectively adopted, such as observation, survey, simulation, assumption, psychological analysis, statistical analysis, quantitative analysis, qualitative analysis, model approach, theoretical analysis, comparative analysis, historical analysis, literature analysis, process analysis, scenario analysis, and case studies.

Frontier analysis includes the identification, comparison, and variation analysis of the world frontiers.

Process analysis includes the analysis on the stages, characteristics, contents, principles, and results of the modernization process.

The Coordinate Analysis of the Modernization Study

The second modernization theory forms an approach to study and mark the development of modernization by using the “modernization coordinates,” which is called the “the coordinate analysis approach of modernization research” for short.

The coordinate system of modernization includes the timetable, the periodic table, the coordinates, and the road map of civilization and modernization. The coordinate system of civilization and modernization consists of horizontal and vertical coordinates. The former may refer to the historical time or the time of civilization, while the latter may refer to the level of civilization, modernization, or the indicators of modernization.

The “civilization time” is a timescale marked according to the “frontier track” of human civilization.

The variable analysis in the coordinate analysis: paradigm analysis, quantitative analysis, time-series analysis, and cross-sectional analysis.

The result statement of the coordinate analysis: marking the quantitative measure, the time-series analysis, the cross-sectional analysis, the paradigm analysis,

and the result of general process analysis in the coordinates of modernization, so as to form the coordinate map and road map of modernization.

The selection of variables: Three factors should be taken into consideration: the variable should be of academic or policy significance, it should be easy to be compared and analyzed internationally, and the data and materials are available and continuous.

Variable types: qualitative and quantitative indicators, the increasing variable, the decreasing variable, the transitional variable, the long-term fluctuating variable, the random variable, the regional variable, the stable variable, and the saturation variable.

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