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Current and Future Trends of Resource Misallocation in the Construction Industry: A Bibliometric Review with Grounded Theory

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Abstract: Resource misallocation (RM) refers to the existence of marginal output inequalities between different industries or companies in an economy. Prior studies of RM have mostly focused on effect analysis, construction industry structure upgrades, and organization management. However, these studies have been fragmented and unrelated. This paper analyzes the status quo, consequences, and emerging trends of RM research at the macroscopic level based on current problems and with the aim of exploring potential solutions. Drawing on grounded theory, a qualitative analysis using text-mining is used to analyze the characteristics of 124 RM-related papers. The results more comprehensively and systematically reveal that current RM research encompasses four major dimensions of sources and concepts, misallocation degree measurement and characterization, focused issues (field), and RM research deficiencies. Methods for measuring RM have also been developed from the simple proportional method to current mainstream methods (e.g., growth rate decomposition and variant substitution). We conclude that, in order for this discipline to thrive and effectively reduce RM, future research into RM should focus on core categories, especially the reform of market-oriented factors, transformation of government functions, construction industrial structure adjustment, and methods of income distribution. This systematic review provides a discipline oversight and uncovers necessary and potential research directions.

Keywords: resource misallocation; grounded theory; market distortion; total factor productivity

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1. Introduction

The global economy has developed rapidly in recent years and attempts to achieve sustainable development is gaining momentum in many countries. Resource misallocation (RM) refers to the situation where resources cannot be optimally allocated between industries or companies because of the interference of existing systems or policies [1]. This suboptimal situation greatly affects a country's total factor productivity (TFP) [2]. TFP refers to the increase in output caused by progress in technology and ability other than the input of elements, such as capital and labor [3]. Some studies suggest that RM is an important reason for the huge wealth gap between countries [2]. Therefore, the allocation of resources has an extremely important impact on the success (or failure) of a country's economic development. The adverse effects of RM also make it harder to achieve sustainable development.

China is a representative example of many contemporary countries. Its current and past situation can be used as a reference to extrapolate results to other developing countries. There are serious RM problems among regions, industries, and companies in China that

significantly reduce its productivity [4]. These largely explain the difference in productivity between China and other more developed countries [5]. Additionally, China is facing a significant transformation of its industrial economic structure, while deepening the reform of its economic system [6]. RM is an important factor that affects TFP and an important channel to improve China's economic growth. Alleviating RM within and between regions can unlock rapid and coordinated development at both country and regional levels [7].

Previous research into RM has partially clarified the mechanism underlying the effect of resource allocation on output efficiency, improved RM's theoretical analysis, and helped understand how government policies conceive resource allocation. However, still under the COVID epidemic impact, the pressure on China's economy is relatively high. China is facing a very unbalanced state of productivity growth in the economy, reflecting a series of resource allocation problems, such as slow productivity gains in many construction market sectors, while sectors with faster productivity gains in the economy as a whole, or market employment share proportion, are becoming increasingly smaller. The market economy of China's construction industry is currently in a relatively long-term adjustment process. The process of deleveraging is far from over and the industrial structure adjustment process is equally so. With the progress of theoretical knowledge and science technology, improving the quality and construction industry market resource allocation efficiency, and solving the bottleneck of productivity are key issues. Some examples are the application of blockchain technology and digital technology resources including from BIM to extended reality (VR, AR, MR, Digital Twins, data capturing technologies, etc.) in AEC industry [8]. This could also become the key to promoting regional integration and high-quality economic development in China.

At present, the existing research has been mainly focused on effect analysis, industry policies, and organization management, but remains highly fragmented. Moreover, qualitative research into the problems and effects of RM is lacking, and there are no macroscopic analyses explaining the current situation, effects, or trends based on wide empirical evidence. Hence, a systematic literature review will help promote further and more coherent RM research in the industry.

This study provides a comprehensive review of the RM-related literature using a qualitative approach combined with grounded theory in order to provide a comprehensive and systematic literature review, and promote further and more coherent RM research in the construction industry from a global perspective. Grounded theory is convenient here as it focuses more on the systematic processing of concepts compared to traditional literature reviews. This study determines the main dimensions and hierarchical structure of the problems and effects of construction industry RM. It also explores the different interaction relationship dimensions to effectively reduce the misallocations involved. The research results will provide a stronger theoretical support for the further study of construction industry RM, as well as promote the transformation and development of industries such as those in China by improving their TFP.

2. Research Methods

This study provides a more comprehensive review of the RM-related literature using a qualitative approach combined with grounded theory. Grounded theory is convenient here as it focuses more on the systematic processing of concepts compared to traditional literature reviews.

2.1. Data Collection

In the context of this research, Resources refers to a source of supply or support, such as materials, money, or human capital owned by a country or region. They can be divided into natural and social resources. Natural resources include sunlight, air, water, land, forests, grasslands, animals, and minerals; social resources include human resources and information, together with wealth created through labor. Scarcity of resources is a basic problem in economics research, i.e., how to use limited resources to maximize social welfare

is a common concern for economists. For the construction industry, this includes life cycle model material resources [9], human resources [10], market investment resources [11], and developing new models [12].

We searched for scientific RM-related papers in the Web of Science, Science Direct, Scopus, and Emerald databases. Both Chinese and English languages were used when looking for potential matches. The main keywords for the literature search were 'resource allocation' or 'resource misallocation' + 'total factor productivity', 'upgrading of construction industry structure', and 'corporate resources'. Chinese papers from 2010 to 2020 and English papers between 2000 and 2020 were selected. Finally, we focused on core journals with high impact factors and/or recognized authors or institutions. As a result, a total of 124 papers were selected with a high relevance to RM. The most recent was published in December 2020 (the month when the literature retrieval stage was concluded). Figure 1 illustrates the literature retrieval and screening process used.

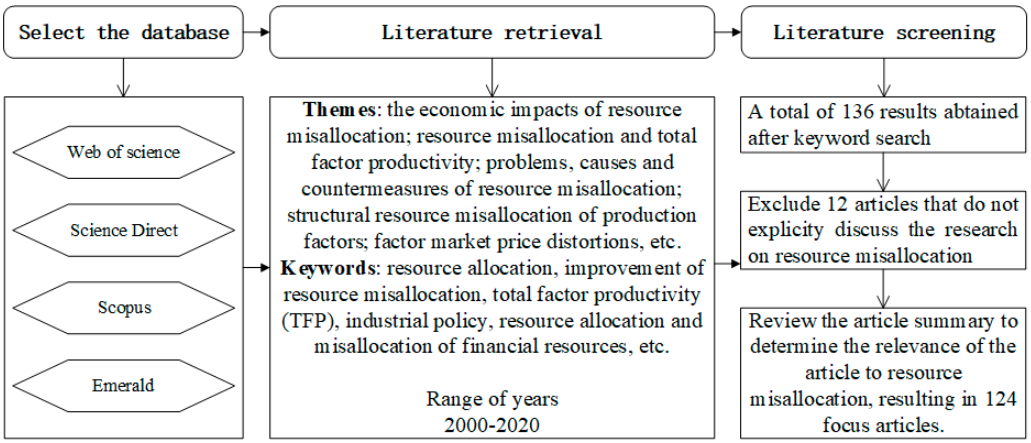

Figure 1. Literature retrieval and screening process.

The systematic review methodology excludes highly influential books, which is recognized as one of the method's potential limitations. However, the exclusion of books is common practice, given these sources are frequently classified as gray literature [13] due to their lack of rigorous peer-review. Many editorial outputs are also not included in scientific databases. Hence, despite some pioneering RM ideas being firstly developed in books -for example, the concept of 'industries assistance' and RM-, they have all been developed in later scientific papers. Consequently, the literature review is expected to be almost as representative as having books included.

2.2. Description of Methods Used

Qualitative research is a general term comprising various research methods, such as ethnography, nature exploration, fragment analysis, case studies, and ecological sample record analysis. Of these, grounded theory is an effective bottom-up qualitative research method that is frequently applied in the social sciences. With grounded theory, information is processed by comparing, analyzing, and transforming data into core concepts to establish theories. Grounded theory's data analysis requirements are quite strict [14]. As Strauss and Corbin (1997) describe, it involves the process of coding the flow of operations that decompose previously collected or translated textual data and identifying phenomena to conceptualize them so that later we can re-abstract, upgrade, and synthesize concepts into new categories. Hence, the aim of grounded theory is to describe the essence and significance of phenomena at the theoretical level but generate it from the analysis of what has been written in the literature. A relatively standardized grounded theory research process is shown in Figure 2 [15].

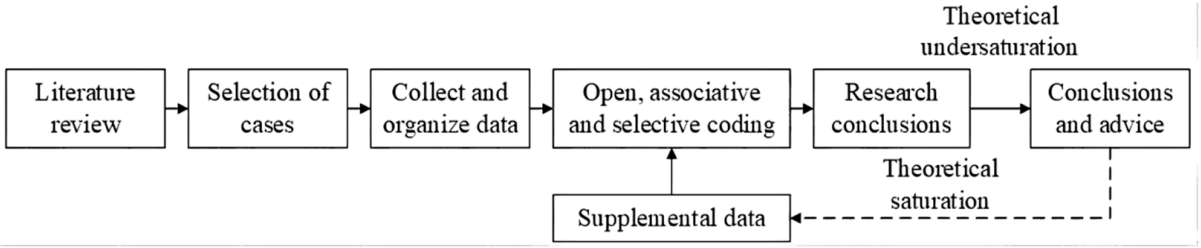

Figure 2. General grounded theory application process.

One grounded theory requirement is that theories are explored and developed from the data in no particular form [16]. The process of data analysis can be divided into three steps, frequently named 'triple coding'. Triple coding comprises open coding, associative coding, and selective coding [17]. Although triple coding is formally presented in three sequential stages, they may contain loops and/or force the researcher to go back while grouping concepts and categories until all the data and categories are consistent [14].

First, open coding focuses on reading relevant texts and discovering a variety of topics. This method is often used in the initial analysis of the literature. It can conceptualize and categorize (downsize) references. Usually, a large number of references is progressively reduced into concepts and categories that correctly reflect the documents' contents. In this process, the original references in the literature, as well as their abstracts and content, are "broken" or "crumbled", then re-instated. The purpose of open coding is to deal with the problem of convergence by identifying recurring phenomena, concepts, and categories.

Associative coding is the second-level coding process in grounded theory. After completing the previous coding task, the categories with high frequency and importance are screened out through the inductive process of "causality → phenomenon → situation → intermediary condition, action/interaction strategy → result". Then, the potential organic context and internal relationships between categories are explored with the use of synonyms, attribute levels, and even personal opinions. Next, we select a certain "axis" category as the core and reintegrate the previously decomposed data to identify any relationships between that main category with other secondary categories and/or problems.

Finally, selective coding involves the continuous comparison of raw materials, concepts, categories, and (especially) category relationships. Selective coding refers to the systematic analysis of the discovered conceptual genera and the selection of a "core genera" [18]. Selective coding is high-level coding in qualitative research. It aims to construct a qualitative theoretical model that describes the research topic based on the conceptual categories and relationships defined in previous relational coding stages. Therefore, selective coding is also called "theoretical coding". Its output involves dividing the research topic into core and supported categories. The core genera are an abstract category with more secondary genera (subgenera) and more coding reference points. This code genera have a large proportion and strong explanatory power in the model. A class outside the core class (but at the same level) is the supported class.

Grounded theory is suited to areas of research where theoretical systems are not yet explanatory and where it is difficult to explain some practical phenomena. It is also suitable when there are significant theoretical gaps and/or new phenomena that keep appearing [14]. As current research into RM is incomplete and its theoretical system is not fully fledged, grounded theory should be particularly useful. Figure 3 provides a flowchart summary of the research method and its major components introduced above.

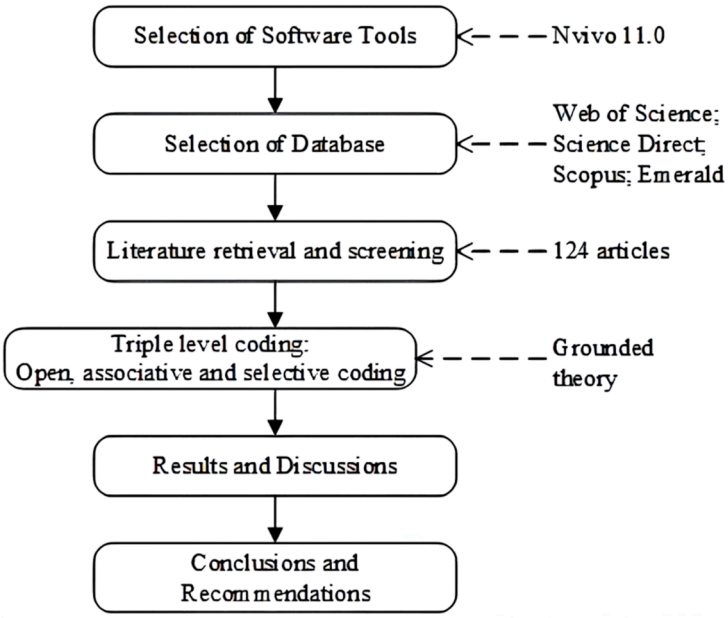

Figure 3. Research method flowchart.

3. Results

Following the grounded theory process outlined above, a system was formed involving 279 coding reference points, 19 basic categories, and 4 core categories as the explanatory model's basis. In this model, the nodes at all levels from the bottom to the top have subordinate relationships, and were formed through a bottom-up induction process.

3.1. Open Coding—Primary Related Factors of RM

The concept genera, or set of primary factors related to RM, was derived from the 124 selected papers, and named from the original texts based on grounded theory's "localization" principle. 19 three-level nodes were obtained by combining and coding the papers' contents. From this, the following direct factors were identified:

- Organizational operation efficiency and regulation, whether the enterprise can overcome financial constraints and the degree of impact of resource mismatching output, control the entry of new enterprises, support or suppress construction companies, and various other government policies;
- Insufficient functional mechanisms and analytical frameworks, research reasons, such as allocating resources through state-owned enterprises instead of the market, economic restructuring costs, trade costs, the informal sectors presence, and resource allocation based on human talent;
- The beginning of the research and the theoretical origin;
- The methods of calculating the RM, such as growth rate decomposition, simple proportional, and variant substitution at the bottom of the subordinate relationship.

3.2. Associative Coding—A Structural Model for RM Research

Associative coding was conducted to further discover and establish the relationships between conceptual genera and their organic correlations. This provided an initial set of 11 s-level nodes, some of which were inferred from the induction and integration of qualitative analysis based on third-level nodes. They represent intermediate elements in the RM analysis. Further qualitative analysis of the 11 secondary nodes revealed four primary nodes located at the top of the subordinate relationship, and embodied macroscopic elements for RM study. Figure 4 shows the structural model.

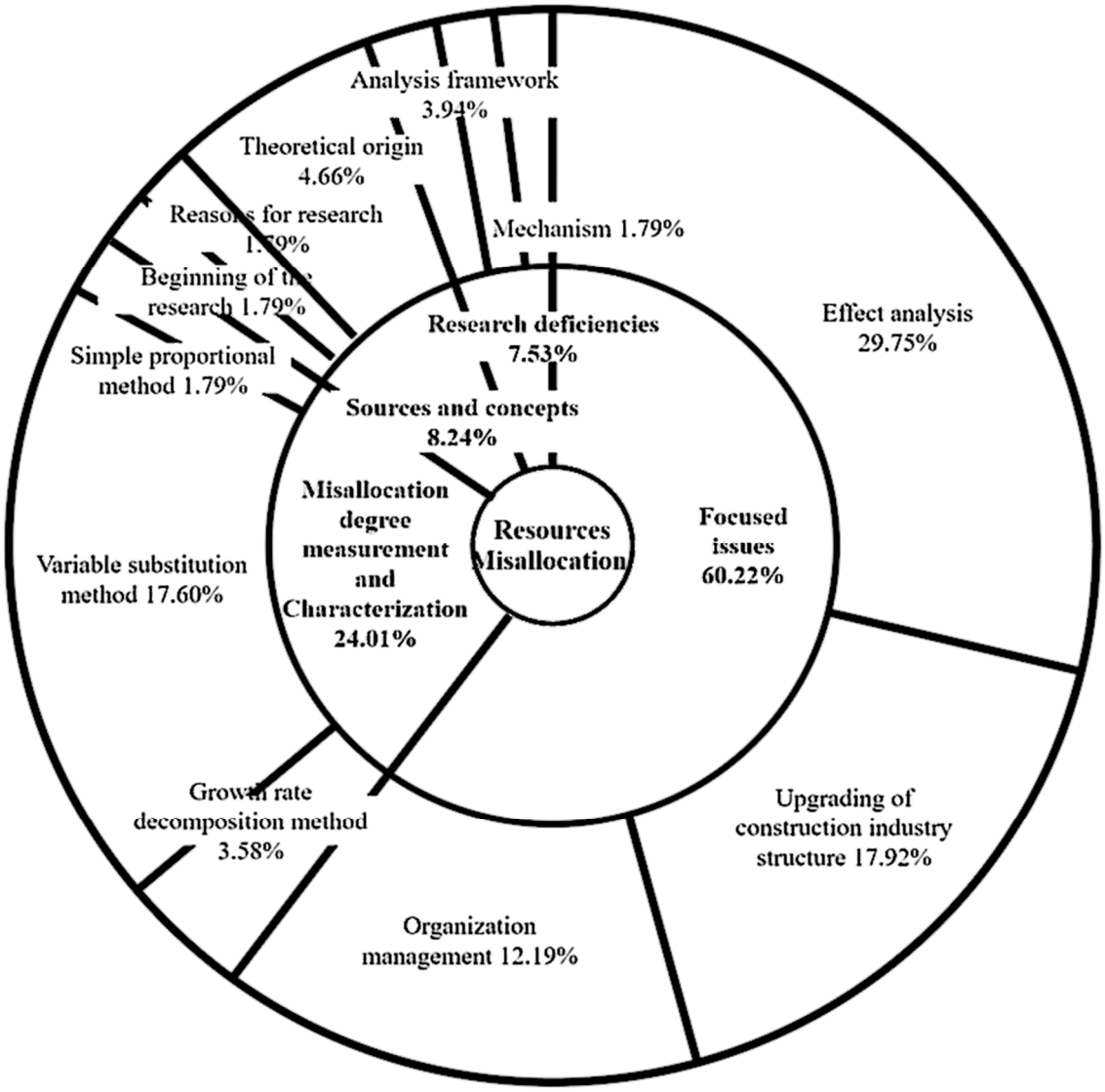

Figure 4. Structural model for RM analysis. Second-level nodes are outside. First-level nodes are inside.

The center of Figure 4 contains the model theme, namely RM. The specific hierarchical structures of the RM-related research elements are represented by two-layer circles. The wedges within each circle reflect the dimensional categories (nodes). As Figure 4 illustrates, current RM studies consist of 4 first-level nodes and 11 s-level nodes. Third-level nodes are not represented due to their large number. The size of each ring sector is determined by the number of coded reference points included. This represents the "volume" (importance) of papers supporting each node and indirectly reflects their influence.

As Figure 4 shows, the *Focused issues* node accounts for most reference points among all first-level nodes. In this category, RM is a popular topic for different effect analyses. Indeed, the analysis of misallocation based on the construction market is also supported by the majority of reference points among all second-level nodes. This indicates that this market environment is still a key factor for improving current RM situations. In particular, the market economy of China's construction industry is currently in the process of relatively long-term adjustment of the industrial structure and needs to be explored further in subsequent studies. In contrast, the *research deficiencies* node contains the least number of reference points and also has the least influence.

3.3. Selective Coding—The RM Research Core

In the final stage, focused issues and misallocation degree measurement and characterization were determined as core categories. These two core genera include 7 subgenera, involving 235 coding reference points and account for 60.2% and 24.0% of the total analyzed, respectively. These two core genera occupy the main position among all genera and represent important links in RM studies. Figure 5 summarizes the final data structure of our selective coding research.

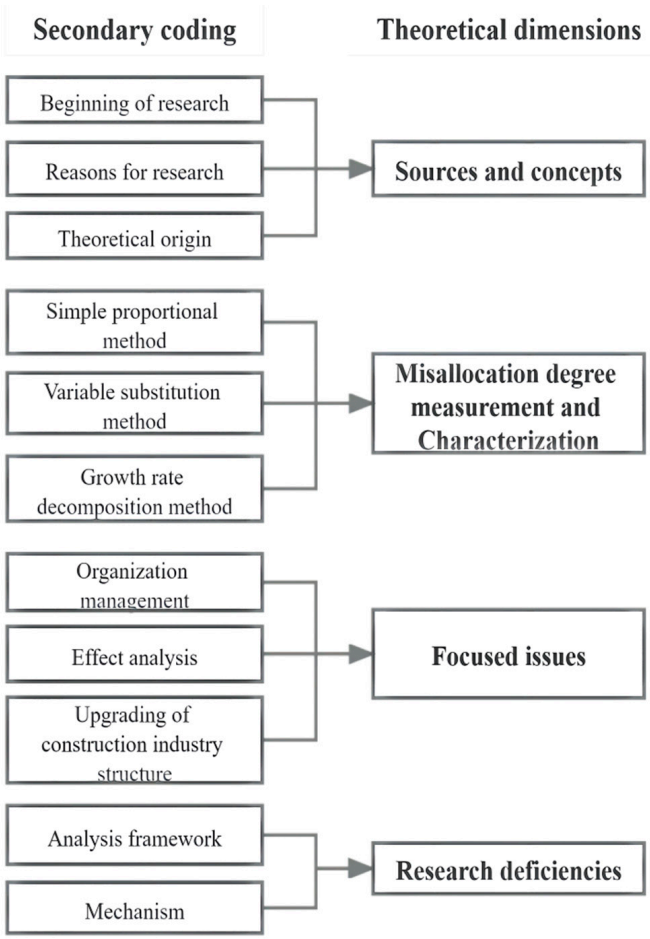

Figure 5. Selective coding data structure.

Focused issues include three specific indicators of upgrading of construction industry: structure, organization management, and effect analysis. Of these, there are a total of 83 effect analysis nodes with the largest number of reference points (49.4%). This again shows that research into the effect analysis system's direction the plays a key role in guiding the effective allocation of resources. Improving the effect analysis system will further improve (optimize) the allocation of corporate resources. Moreover, the *measurement method* contains three specific index points: the simple ratio method, variable substitution method, and growth rate decomposition method. Of these, there are a total of 52 variable substitution method nodes with the largest number of reference points (77.6%) of the effect analysis node. This shows that the measurement method using the variable substitution method for robustness tests reflects the RM level being measured in many practical settings. Conversely, *sources and concepts* and *research deficiencies* are relatively minor.

Moving forward, we focus on the core and supporting *genera*'s high-frequency nodes of *sources and concepts*, *focused issues*, and *misallocation degree measurement and characterization* for the model's explanation. *Research deficiencies* represents a very low-frequency node and is not developed further.

(1) Sources and concepts

As Table 1 shows, *source and concepts* can be considered the entry point in current research.

Table 1. Key literature reviews of sources and concepts.

Research Direction	Research Connotation	Key Literature
TFP	TFP as a measure of technological progress to explain the efficient functioning of an economy and ways to improve its productivity.	Solow [4]
	Assess the scope of input misallocation in Italy and its impact on aggregate output and TFP.	Lenzu [19]
Shortage of service demand	Differentiate between the concepts of "need" and "demand" for medical services and provide a concept of "shortage" in this context.	Jeffers [20]
TFP growth decomposition	Decompose TFP growth into the industry's own TFP growth and the allocation effect of factors among industries.	Syrquin [21]
Structural adjustment policies	Any anti-diversification policy directly limiting the realm or range of business activities without correcting the business environment may not be effective and will create serious RM.	Jwa [22]
Misallocation in various fields	Resource prosperity increases the value of power by providing more resources for politicians and exacerbating misallocation in various fields.	James A [23]
Concept formation	Provide a new analytical perspective for TFP growth.	Hsieh [24]
Enterprise productivity	Imperfect market mechanisms exacerbate the distortion of allocation of and enterprise factors, and restrict improvement in enterprise production efficiency.	Zhigang Yuan [25] Yongwei Chen [26] Deming Luo [27] Huihua Nie [28] Zhen Yang [29]
Changes in ecological efficiency	Environmental regulation and RM factors are introduced to identify the key factors influencing ecological efficiency.	Wang [30]
Outward foreign direct investment (OFDI)	RM, as an essential characteristic of China's "progressive reform", has become a significant factor restricting high-quality OFDI.	Kong [31]

The sources and concepts node includes three secondary nodes: theoretical origin, research beginning, and research reasons, with a total of 23 reference points. Of these, there are 13 theoretical origin nodes, which contain most reference points and occupy a relatively important position. At the beginning of the research, there are 5 reference points and the reason for the research occupies 5 reference points. The number of points included is small and its impact is small too. The number of reference points for each secondary node is equally small, as is their gap, indicating that the source of RM and the concept's dimension have received little attention (apart from the theoretical origin).

In general, the allocation of resources at both macro and micro levels will be continuously optimized and updated due to the continuous development and change of external market environments. Therefore, its sources and concepts are often ignored or not widely mentioned. Table 2 shows the number of nodes at all levels and coding reference points included in sources and concepts node.

Table 2. Number of nodes at all levels and coding reference points included in the sources and concepts node.

First Level Node	Secondary Nodes	Three-Level Nodes	Number of Coding Reference Points
Sources and concepts (3)	Beginning of research		5
	Reasons for research	Allocate resources through state-owned enterprises instead of the market	5
		Economic restructuring costs	
		Trade costs	
		Presence of the informal sector	
		Cannot allocate resources based on human talents	
	Theoretical origin		13

(2) Focused issues

Whether it is the (1) factor allocation efficiency of micro-enterprises; (2) construction industrial organization efficiency at the meso-level; or (3) changes in the macro-level demand structure, technological progress, and the quality of economic growth. RM has caused a decline in economic growth. The RM problem's research and exploration can be divided into such different aspects as the effect analysis and organization management. Table 3 shows the result created from analyzing the data relating to *focused issues*.

Table 3. Key literature relating to *focused issues*.

Research Direction			Research Connotation	Key Literature
Effect analysis	Overcoming the impact of	Financial friction	Financial market friction causes the misallocation of resources in the initial stage, which greatly hinders the convergence of high-speed growth to a steady-state equilibrium path.	Francisco J Buera [32]
			Enterprises can accumulate enough capital and self-correct the "first type of misallocation" caused by financial market friction.	Abhijit V. Banerjee [33]
		Corporate debt	Reveal the truth of the decline of investment efficiency and the misallocation of financial resources behind the deviation between the asset-liability ratio and the macro-debt ratio of Chinese enterprises.	Pan [34]
	Impact on outputs	TFP dispersion and impact	The dynamic process of controlling productivity shocks determines misallocation and income disparities.	Asker [35]
		Productivity gap among enterprises	RM among enterprises is an important reason for a low TFP.	Lewandowskakalina [36]
		TFP differences among countries	The redistribution of factors between heterogeneous production units is an important source for measuring TFP differences between countries.	Restuccia [37]
		Impact on productivity	The misallocation caused by financial market distortions can explain 10% of the total misallocation at most, and its impact is minimal.	Abhijit V. Banerjee [33] Virgiliu Midrigan [38]
	Market distortions	Operating effectiveness	The effectiveness of market operations has an impact on the cost of capital acquisition, allocation efficiency, and entrepreneurial behavior by enterprises.	Buera [32]
		Market malfunction	Banking system malfunctions will increase RM.	Ziebarth [39]

Table 3. *Cont.*

Research Direction		Research Connotation	Key Literature
Upgrading of construction industry structure	Scale control	Policies restricting large enterprises and supporting SMEs have depressed the scale of enterprises in the economy and caused a misallocation of resources in low-productivity SMEs.	Guner [40]
	Construction organizations	RM of manufacturing policy will reduce TFP.	Hsieh [24]
	Entry regulation	The countries with loose entry regulations have higher TFP levels and productivity than strictly regulated countries.	Barseghyan [41]
	Inappropriate organizational policy	Inappropriate industrial organization policies distort resource allocation and cause serious misallocation and loss of TFP and output.	Repetto [42]
	Development zone evaluation	Improved system efficiency can alleviate the policy impact of development zones on the misallocation of regional resources.	Bai [43]
	Government intervention and special rules	The level reached by social planners that allocate the current aggregate output across mines, so as to minimize emissions, conditional on some well-defined extraction rules.	Jac [44]
Organization management	Market distortion	Assesses the degree and impact of distortions in the construction market.	Chang-Tai Hsieh [24]
	Job supply and demand	A serious mismatch between job supply and demand will cause a large number of laborers to be "misallocated" and become unemployed, thereby raising the labor cost of construction enterprises.	Sahin [45]
	Entrepreneur or worker decisions	Fluctuations in input prices lead to the misallocation of talent between entrepreneurs and the salaried sector.	Sargent [46]
	Labor allocation in the construction industrial sector	Increased labor-misallocation of resources significantly hampers low-carbon productivity gains.	Xiaolan Deng [47]
	Internal influence mechanisms of labor allocation	Guiding the diversion and transfer of labor resources according to local conditions and improving allocation efficiency will provide human and capital support for the optimization and upgrade of construction industrial structure.	Ai Ma [48]

The focused issues node has a total of 168 reference points, which is the largest of all the first-level nodes, and also the most important in the entire research field. The effect analysis node is also the main node with more related publications. It has the most reference points of the three second-level nodes included in focused issues (a total of 83). Financial constraints and output efficiency also have a particularly important impact of RM from the three-level nodes included. Without fair, open, and transparent market rules and strict compliance supervision, the party with less information is very likely to be seriously disadvantaged. In this situation, the market mechanism can hardly allocate funds effectively, as effect analyses are markets with extremely asymmetric information. Moreover, the development of effect analysis can lead to more investment in growing industries and the withdrawal of capital from declining industries to improve capital allocation efficiency [34]. Therefore, more research into the misallocation of resources in effect analysis is also needed.

Furthermore, there are a total of 50 upgrading of construction industry structure nodes, which contain more reference points. Since upgrading construction industry structure can identify the industries in need of the Chinese government's intervention currently [49], it also plays an important role in reducing enterprises' RM and improving production efficiency. The organization management node is a minor node with a small number of publications, but still contains 34 reference points. The analysis shows that, in many developing countries, the influence of RM caused by construction market distortions, such

as the unemployment rate or enterprise labor costs, is still relatively large [45]. Table 4 shows the focused issues node at all levels and coding reference points.

Table 4. Number of nodes and coding reference points in the focused issues node.

First Level Node	Secondary Nodes	Three-Level Nodes	Coding Reference Points
Focused issues (3)	Effect analysis (main node)	Overcoming financial constraints	83
		Impact on outputs	
	Upgrading construction industry structure	Control the entry of new businesses	50
		Support or suppress construction companies	
		Other government policies	
	Organization management	Organizational efficiency	34
		Corporate regulation	

Table 5, Figures 6 and 7 show the results of a grouping word frequency query applied to the 124 selected publications, identifying the most popular research foci in different periods. Figure 8 also shows the keyword cluster analysis results obtained by VOS viewer software based on keyword classification.

Table 5. Most popular research focuses.

Period	High-Frequency Words (Valid Words and Weighted Percentage Higher than 0.5%)	Research Focuses
2010–2015	Enterprises, resources, industries, factors, allocation, productivity, economy, capital, China.	Enterprise productivity; TFP; distortion of resource allocation.
2016–2020	Resources, enterprises, economy, allocation, elements, industry, capital, industry, China.	Market distortion and misallocation of resources; influence of RM on TFP; misallocation of factors caused by industrial structure imbalance.

Figure 6. Word cloud for the 2010–2015 research papers.

Figure 7. Word cloud for the 2016–2020 research papers.

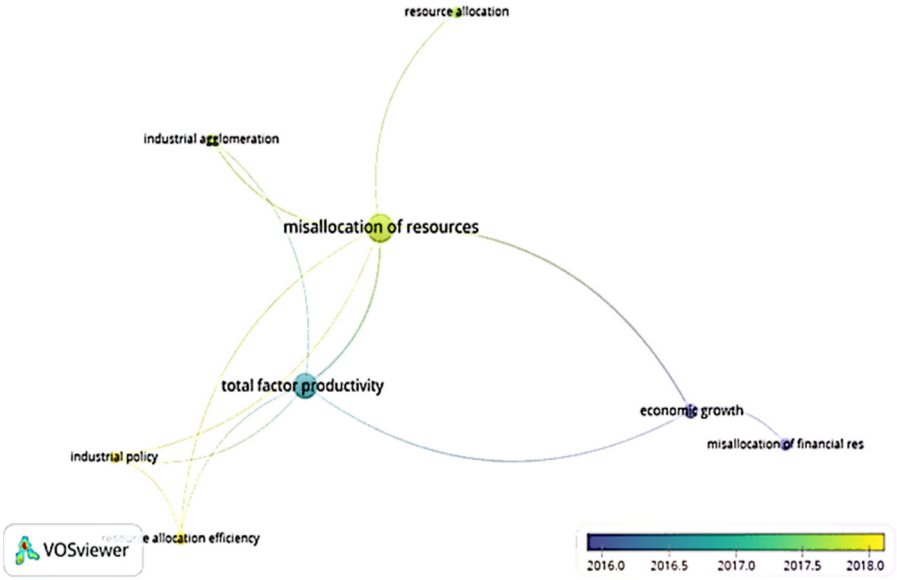

Figure 8. Keyword cluster analysis based on keyword classification.

The core issue is to manage the relationship between the government and the market in such a way that the market can play a decisive role in resource allocation and better reflect the government's role. Therefore, the most popular research focuses range from simply studying economic benefits, TFP, resource allocation, and other issues, to more in-depth research on the effect of market distortions on RM, as well as that of resource mismatching on TFP.

At the same time, there is an urgent need to strengthen the research and exploration of "extension misallocation". Both extensional RM defined by Banerjee and Moll (2010) or the net entry effect calculated by Brandt [50] are based on the difference in the literature between the TFP entering and exiting the enterprise. The effective dynamic replacement of enterprises should comprise three ways to realize the effective allocation of resources: (1) the entry of potentially high TFP companies and the exit of existing low TFP companies (selection effect); (2) after entering, the potentially high TFP companies achieve rapid

growth of their own TFP and narrow the gap with incumbents or even surpass incumbents through acquired learning (learning effect); and (3) the process of enterprise entry and exit creates competitive pressure on the incumbents and forces them to improve their TFP (competitive effect).

These three effects together constitute the connotation of the process of optimal allocation of external resources. Distortion of the normal entry and exit process of enterprises will directly lead to the misallocation of extended resources. Therefore, it is necessary to overcome technical defects, exhaustively consider various distortive policies, further analyze the causes of RM and market distortion, and make a more accurate prediction of efficiency loss.

(3) Methods of misallocation degree measurement

RM leads to a loss of production efficiency. It is of theoretical and practical relevance to measure the degree of misallocation and its influence on productivity accurately [4]. It is necessary to clarify the mechanism and degree of efficiency loss caused by RM before attempting its rectification, while, a comprehensive understanding of the practical problems involved is needed to formulate policies to solve the RM problem, and thus help improve the economic benefits of enterprises and promote the economy and society's sustainable development. Table 6 shows the current methods used for measuring the efficiency loss caused by RM.

Table 6. Key literature for resource misallocation degree measurement and characterization.

Research Direction		Research Connotation	Key Literature
Simple proportion method	TFP ratio of 90/10 enterprises	90/10 of all state-owned and above-scale enterprises have decreased and their average TFP increased year by year.	Huihua Nie [28]
	75/25 quantile difference	The degree of misallocation can be measured by productivity dispersion but may be interfered with by endogenous and selective change.	Puyang Sun [51]
Variable substitution method	Use TFP to measure the degree of distortion of resource allocation across enterprises.		Klenow [24]
	Incorporate the cost of using elements into the analytical framework for studying misallocation.		Zhen Yang [29]
	Marginal product income of production factors as a tool to measure the allocation distortion.		Guan Gong [52]
Growth rate decomposition method	Efficiency loss	Decompose TFP into technical efficiency, resource allocation efficiency, and economies of scale.	Ariel Pakes [53]
	Decompose the TFP growth rate into the industry's internal productivity growth effect, the positive effect of output share on productivity growth, and the resource reallocation effect.		Nordhaus [54]
	China's construction industry has a strong dependence on intermediate products. The introduction of intermediate input factors is more indispensable when studying the TFP and the growth of the specific sector.		Zhen Yang [29]

There are 67 reference points in total, including three second-level nodes: the variable substitution method, simple proportion method, and growth rate decomposition method. Of these, the variable substitution method is the main node with more related publications and 52 nodes. It contains the most reference points and occupies an important position in the Misallocation degree measurement and Characterization nodes. This, in turn, indicates that it is more suited for use when conducting a robustness test in RM measurement. The growth rate decomposition node contains the relatively small number of 10 reference points. In addition, the simple proportional method has a total of 5 reference points, with the least number of points and the least impact. This means that the simple proportional method is seldom used in the literature and is often ignored (or needs further study). A simplified

study of problems related to resource allocation from the perspective of misallocation degree measurement and characterization can better reflect the extent of specific RM and effectively solve complex allocation problems.

Here, we considered the relationship of various dimensions and believe that misallocation degree measurement and characterization have a strong correlation with the sources and concepts and focused issues nodes. We conducted the measurement of the specific allocation of related resources and a quantitative study of their level of correlation (Table 7).

Table 7. Number of nodes at all levels and coding reference points included in the misallocation degree measurement and characterization node.

First Level Node	Secondary Nodes	Coding Reference Points
Misallocation degree measurement and characterization (3)	Simple proportional method	5
	Variant substitution method (main node)	52
	Growth rate decomposition method	10

The simple proportion method assumes a perfectly competitive market and uses productivity dispersion between firms to describe the degree of RM. The common indicator is the ratio of 90/10 firms' TFP. The greater the difference in TFP among firms, the more serious the degree of RM. This method has simple steps and is convenient to use for measurement. However, solely relying on the TFP ratio is insufficiently representative and may be distorted by endogeneity and selectivity biases.

With the gradual deepening of the analysis of corporate TFP and economic growth, a model of monopolistic competition was built with the variable substitution method used for its misallocation degree measurement and characterization. The TFP variance was used to measure the degree of distortion of resource allocation across companies. This method allowed us to demonstrate that the greater the difference in TFP between companies, the smaller is the total industry TFP. The assumption of constant returns to scale was gradually relaxed. The Levinsohn-Petrin semiparametric estimation method was used to estimate the cross-industry capital and labor output elasticity of China's construction industry. In addition, the marginal product returns of production factors were used as a tool for measuring the resource allocation distortion and the potential growth of manufacturing TFP after the Pareto improvement of a single factor allocation.

Furthermore, with the continuous improvement of data acquisition methods and the increasing availability of micro data, RM research has gradually moved from the macro to the micro level. At present, the general way of measuring RM-caused efficiency loss in many countries is the growth rate decomposition method. For instance, it is possible to decompose TFP growth into the industry's own TFP growth and the allocation effect of factors among industries. This operation allows the impact of structural changes in a country's production efficiency to be analyzed. It also enables the reallocation of resources between industries when we decompose it into the simply increasing industry share input effect and the factor price distortion effect.

Finally, with the continuous updating and maturity of theoretical models, the misallocation degree measurement and characterization have changed from a simple proportion to such other current mainstream methods as growth rate decomposition, DSEG, variable substitution, and the Aoki method. These methods not only measure RM between industries and within companies, but also can measure the impact on RM of different ownership systems, among regions, and even gradually measure the RM level of a whole national economy. All of these are relevant applications that can prevent negative effects on TFP and avoid hindering economic growth [55]. Therefore, the impact path of intermediate inputs should be considered when measuring construction industrial outputs. Intermediate inputs should also be included in the growth accounting framework when measuring the impact on the overall TFP. This will allow the impact of industrial TFP on overall TFP to be more

accurately estimated, and the misallocation degree measurement and characterization to be continuously improved, to eventually solve specific RM-related problems.

3.4. Saturation Test

The saturation test involved randomly reserving 10 journal papers before coding, encoding the remaining 114 papers, and then recoding the 10 papers again. Upon performing this operation, it was found that all existing codes and categories coincided. That is, there were no new codes related to the study's topic, which was taken to mean that theoretical saturation had been achieved [56].

4. Discussion and Implications

4.1. Discussion

This study adopts a bottom-up qualitative research method with grounded theory to compare, analyze, condense, and summarize the main dimensions and hierarchical structure of RM concepts:

1. Current RM-related research involves a three-layer structural model. The first layer analyzes and describes the macro elements of RM. This layer contains 4 nodes in total: sources and concepts, misallocation degree measurement and characterization, focused issues, and research deficiencies. The second layer involves the study of intermediate elements and most of the RM direct elements. This contains 11 nodes: research beginning, the reason for the research, and the theoretical origin; the simple ratio method, the growth rate decomposition method, and the variable substitution method; the organization management, the upgrading of construction industry structure, and the effect analysis; and insufficient research on the mechanism of action and framework of analysis. Each node has a different influence and has also experienced a different amount of research activity
2. Focused issues and misallocation degree measurement and characterization are the "core categories" for exploring the RM problem, while sources, concepts, and research deficiencies are the "supported categories". The latter are not explained in this paper because their impact on RM is minimal. The research on the current and future trends of resource misallocation in the construction industry also has no core value.
3. With more RM-related research being developed and the updating and maturity of economic theoretical models, more methods for measuring RM have also been developed. These range from the simple proportional method to current mainstream methods (e.g., growth rate decomposition and variant substitution). This makes it possible to further analyze quantitatively the impact of RM changes in specific industries, including from BIM to extended reality (VR, AR, MR, Digital Twins, Data capturing technologies, etc.) in AEC industry. It also allows the factors that condition production efficiency between industries to be better understood.

4.2. Implications

This study develops a theoretical model to study the dimensions of the resource misallocation problem and shows that certain elements play a dominant role in the process (Figure 9).

More studies are urgently needed to explore the effects and influences of different market distortions on TFP. This will allow the implementation of more effective industrial policies and improved enterprise production efficiency while optimizing the country's economic structure. At the same time, it is important to identify effective methods for optimal resource allocation and reducing operating costs. For example, we suggest establishing market-oriented and rule-of-law mechanisms for the 'survival of the fittest' and match scientific technological progress paths to meet a substantial proportion of social production needs. Moreover, attracting investment that follows equal national treatment and pre-entry national treatment, and respects intellectual property rights and other principles, provides a significant way to develop the local economy, and provides development motivation

and experience (such as capital, talents, technology, products, markets, and management methods for open areas).

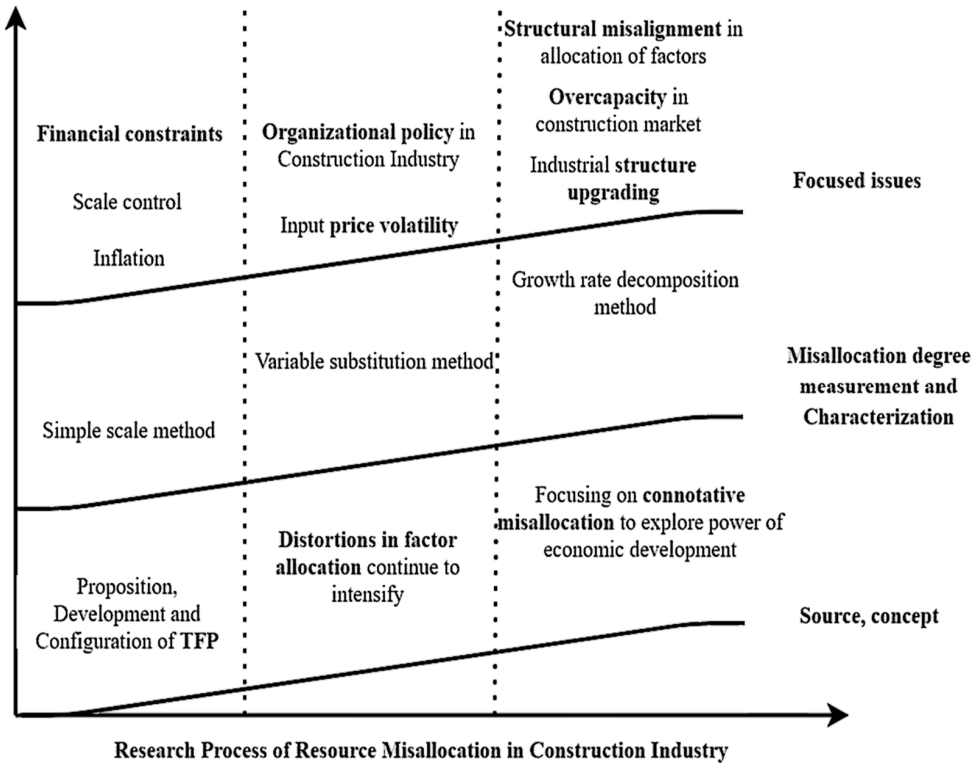

Figure 9. Dimensional model of resource misallocation.

Further improving management system design can also help achieve mutual benefits and complementary resources. When a higher resources efficiency is achieved, it will be possible to solve other core problems of the national economic system and promote the transformation of an economy from the traditional extensive growth model to a new sustainable version.

Overall, future studies would benefit from focusing on "core categories" and "supported categories". This can be achieved by concentrating on endorsing market-oriented reforms, transforming government functions, adjusting industrial structure, and implementing income distribution methods. At the same time, it is important to understand that RM is all-pervasive in many industries, companies, and national economies. Nevertheless, the value of marginal output—the increased revenue of a firm's additional use of a unit factor under conditions of perfect competition—still needs more in-depth empirical research on whole markets, industries, and companies from macro and micro perspectives to verify the conclusions of this study. This will allow the enrichment of the hierarchical dimensions and RM model structural elements proposed here.

5. Conclusions

RM-related research is at the core of economic theory, but usually involves regression analysis with a single explanatory variable. Consequently, there are many limitations, gaps, and deficiencies both in the RM analysis framework and its explanatory action mechanisms. For example, although studies have found that intermediate products are extremely important factor inputs in addition to capital, labor, and other basic factors, it is difficult to obtain data from intermediate inputs and purchased intermediate services from enterprises due to the data availability restrictions. Nevertheless, this influence path of intermediate input needs to be considered when calculating industry output, which means it is necessary for inputs to be also included in the RM growth accounting framework.

In this regard, measuring the impact of intermediate input itself on the overall TFP, for example, could more accurately predict the impact of the industry's TFP on the overall country's TFP.

Similarly, RM-related research in practice tends to explore the influence of individual factors in one dimension. That is, it neglects the potential mutual (interrelated) effects of these factors. Currently, the impact of market distortions (such as RM finance and labor) and changes in the process of TFP need to be resolved. The existence of RM is reflected in the excess of return on capital of individual companies by observing simple cross-sectional data at the micro level. But this excess of return on capital is the driving force behind most companies when innovating and improving productivity. Hence, RM's effect on the economy's overall productivity needs to be explored in both theory and practice. Additionally, errors of measurement and the existence of "externalities" in the production process may affect the estimation of efficiency loss. In particular, the (unobtainable) changes in the input of production factors will always lead to the inaccurate estimation of an enterprise's productivity. However, the literature has not yet considered any of this.

Finally, there is still a lack of countermeasures to solve RM-related problems. In real settings, concrete feasible improvement measures from governments or enterprises remain undeveloped. To address this gap, the cooperation between governments, scholars, disciplines, and institutions would be ideal—the aim being to build a high-level, comprehensive, and pioneering academic exchange platform to further develop more RM-related research with a special application to practical settings.

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