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# Implementation of sustainable public procurement in China: An assessment using quantitative text analysis in large-scale tender documents

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In recent years, increasing attention has been paid worldwide to the sustainable development of the economy and society. Because of its size and prevalence, public procurement has always been a powerful policy tool used to tackle issues related to the sustainability of society, economy, and environment. China has attached high priority to sustainable development, and many aspects of sustainable public procurement (SPP) have been implemented though no official documents have referred to the concept of SPP. Therefore, little is known about the actual implementation and patterns of SPP in practice. The purpose of the study is to assess the actual implementation and patterns of SPP in China. We obtained 42,369 public procurement documents for 2015–2020 using the web crawler technique and the actual implementation of SPP was assessed through the text-mining technique. The research shows that SPP is implemented in more than 82% of the documents and appears in an upward trend in the past 6 years. Several patterns of SPP implementation are also identified. First, most documents implement more than one category of SPP. Second, small and medium-sized enterprise-oriented procurement is the most implemented SPP main category, overtaking environmentally friendly procurement only by a small margin, and the procurement for the circular economy is the least implemented. Third, there seem to be some relationships between the level of SPP implementation and the award method, tender price, and contract type. Finally, there is a substantial transformation of China's SPP toward social aspects of SPP in recent years. Policy implications, limitations, and issues for future studies are also discussed.

## KEYWORDS

sustainable public procurement, text mining, web crawler technique, implementation patterns, China

## Introduction

In recent years, countries around the world have increasingly focused on the sustainable development of the economy and society (UN, 2022). Because of its size and prevalence, public procurement often played an important role during this process, not only as an essential tool to purchase public goods and services but also as an effective way of implementing policy (Cao, 1998; Uyarra and Flanagan, 2010; Brammer and Walker, 2011; Kiiver and Kodym, 2015; Cao and Zhou, 2018). Based on the concept of sustainable production and consumption, the United Nations Open Group on Sustainable Development Goals (SDGs) officially announced the launch of the Sustainable Public Procurement (SPP) program in 2014 (UN, 2014). Subsequently, SPP has become the focus of sustainable production and consumption and an important practical field in which to promote sustainable development in the world.

As a strong supporter of the United Nations Millennium Development Agenda and an active advocate of addressing climate change issues (UN, 2015; Jiang et al., 2022), China has many favorable policies for sustainable development. In 2020, the scale of public procurement in China accounted for about 3.6% of GDP and reached more than 3,697 billion RMB (Ministry of Finance, 2021). Because of the benign policy environment and sheer size, public procurement has become a powerful policy tool in environmental, economic, and social development in China, such as strengthening ecological protection, fostering the development of minority areas, and promoting innovation of enterprises all over the nation (Cao, 2014; Ouyang et al., 2020; Jahanger et al., 2022). Many Chinese laws provide legal grounds for implementing certain aspects of SPP. For example, the “Government Procurement Law (GPL)” establishes policy goals that aim for national, economic, and social development (UNEP, 2015). Other laws also provide a strong linkage between public procurement and many aspects of SPP such as energy conservation, innovation, circular economy, and development of small and medium-sized enterprises (SME) and disabled-related enterprises (Cao, 2013; Shen et al., 2017; Wang et al., 2018).

However, it is quite generally accepted that having a policy does not equate with implementation as implementation is always complex. Theoretically, the deviation in the formulation and implementation of public policies has long attracted the attention of academic research (Pressman and Wildavsky, 1973). As Kristensen (2021, p.1) recently pointed out, “the difference between practices and policies is noticeable in public procurement.” Specifically, it has been recognized that having an SPP policy does not guarantee its successful implementation in practice, as several barriers have been identified that prevent public procurers from fully implementing SPP in their procurement such as financial strains and lack of knowledge or motivation (e.g., Sourani and Sohail, 2011; Grandia, 2015; Grandia and Voncken, 2019). Thus, certain established aspects of SPP policy under Chinese laws may

require an assessment to determine their actual implementation in practice. Furthermore, the need for assessing the actual implementation of SPP in China may be even more pressing, as SPP is not a well-established policy concept in China (Yang, 2016; Qian and Cao, 2017), in the sense that there is no reference to the term of SPP in any official documents, and without an established SPP policy, the actual implementation of SPP may be misinterpreted and certain key aspects of SPP may be neglected. It may further queer the pitch for China to measure its SPP experiences with those of the developed and developing economies, to enhance international dialog and collaborations, in the context of global sustainable development and climate change mitigation.

The study, thus, seeks to investigate the implementation of sustainable public procurement in China, addressing an interesting, timely, and important research area. The current literature on SPP in China is insufficient to address the issue in terms of both research scope and methodology. First, in terms of the research scope, extant studies are mostly confined to the environmental aspect of SPP (Ma and Cheng, 2007; Yan and Cao, 2010; Cao and Zhou, 2014; Gui et al., 2021), and therefore, broader aspects of SPP deserve studies encompassing not only environmental but economic and social sustainability as well. Second, in terms of methodology, while some studies do cover a broader aspect of SPP (Zhang et al., 2012; Schwerin and Prier, 2013; You and Lei, 2020), they are mostly qualitative in terms of the research method. Even in the limited number of quantitative studies, the research data are collected through interviews or questionnaires (Zhu et al., 2013; Liu et al., 2019), which could cause “self-selection” and a “low response rate” to the research findings to a certain extent (Walker et al., 2012).

We improve current research in terms of both scopes of study and methodology. We first establish a recognized SPP concept reflecting the most recent developments of sustainability in the context of public procurement. We then develop a more objective and quantitative assessment method based on that established full concept of SPP. Meanwhile, we obtained 42,369 procurement documents using web crawler technology and discovered the implementation status and patterns of SPP in China using text-mining techniques. This research method can avoid some disadvantages through interviews or questionnaires and is suggested to be used by Grandia and Kruey (2020).

To sum it up, the primary goals of this study lie in three folds: one, to fill in the scholarship gap and assess the practical implementations of SPP in China based on the recognized SPP concept by using big data and computer technology, i.e., a quantitative text-mining method. Two, to further benchmark our findings with other studies to identify convergences and divergences of SPP implementation. Three, to a lesser extent, we explore the complex connection between policies and implementation. Specifically, this study raises four research questions:

- 1) How to establish a comprehensive assessment system in China that is based on the internationally recognized concept of SPP?
- 2) What is the actual implementation of SPP in China in practice?
- 3) What kind of patterns can we identify therein in China?
- 4) What convergences and divergences and strengths and weaknesses of SPP implementation (and policy) of SPP can be found comparing the Chinese experience with certain global experiences?

Our research has three main contributions: first, we are the first to use large-scale tender documents from China and the text-mining method to analyze the implementation of the full aspects of SPP in China. In doing so, we directly respond to the call from a prior study (Grandia and Kruyen, 2020) which suggests further research into similar issues by using a more quantitative method in different countries or regions, to offer a more fine-grained understanding of the actual implementation of SPP. Second, we compare our results and conclusions drawn from China with the extant research on China and globally, especially in Belgium, on the implementation of SPP. We find both convergence and divergence, strength and weakness, and certain neglected aspects of SPP, the reasons for which require further inquiries. Third, we further explore the theoretical and practical complex connection between policies and implementation. We find cases where strong political commitments and clear rules play an important role in promoting sustainable procurement, indicating a positive connection between clear legal policy requirement and robust implementation; we also find cases where certain aspects or areas of SPP implementation are neglected or missing even in a strong positive policy environment, suggesting further themes of future research including the study of the need for more linkage between sustainable policy and procurement.

Our research may also have certain policy implications for policymakers and procurement managers, to help raise the policy awareness of SPP and with the potential development of a detailed assessment system of SPP. The research is particularly relevant to jurisdictions where the recognized policy concepts of SPP have not yet been established. Additionally, endorsement of the SPP policy and assessment of its appropriate implementation not only contribute to the improvement of the public procurement system but also promote the overall sustainable development goals.

The study is structured as follows: the *Sustainable Public Procurement* section explores the internationally recognized concept based on which we could develop our assessment system and review and compare the current assessment methods of SPP toward building an objective and quantitative assessment method of our own. The *Methodology* section expounds on the assessment system and research strategies established in this study, including data collection and

analysis. The *Results and Discussion* section contains the results and analysis of the actual implementation and patterns of SPP in China. The *Conclusion, Policy Implications, and Limitations* section concludes with the implications and limitations of the study and possible issues for future research.

## Sustainable public procurement

### The concept of SPP

As said earlier, although there are laws mentioning certain aspects of SPP, there is no reference to the concept of SPP in any official documents in China. It is, therefore, imperative that we explore the internationally recognized concept of SPP in the first place based on which we develop an objective and quantitative assessment method.

A comprehensive understanding of the concept of SPP can be derived from policy, literature, and practice. At present, many countries and regions around the world have adopted a formal and standardized policy concept of SPP (see [Supplementary Appendix Table SA1](#)). A generalization of the SPP concepts from international organizations and countries reveals that in addition to the prevalence of environmental aspects, SPP is particularly concerned with emphasis on the economic and social impacts of public procurement activities, often referred to as the three Ps (people, planet, and profit).

Prior studies present different definitions and concepts when discussing sustainable procurement developments in the private and public sectors. These studies use terms such as green procurement (Bolton, 2008), sustainable supply chain management (SSCM) (Carter and Rogers, 2008; Amann et al., 2014; Grosvold et al., 2014), environmentally responsible public procurement (Li and Geiser, 2005), and sustainable procurement (Walker and Brammer, 2009). Due to the large number of definitions and terms, it is not always clear what they mean in practice or even in academia, which could result in confusion and make it difficult to paint an overall picture of sustainability in the context of procurement (Grandia and Kruyen, 2020; Sönnichsen and Clement, 2020). Therefore, the first thing we will do in the study is to find a recognized and specific definition of SPP to better understand the implementation of SPP and ensure a clear operationalization.

Most literature describes SPP from three dimensions: procurement activities should embody the development of the environment, economy, and society at the same time (Prier et al., 2016; Stoffel et al., 2019; Grandia and Kruyen, 2020; Raj et al., 2020; Etse et al., 2021). In the early days, the definition of SPP varied slightly among scholars. Preuss (2009, p.214) and Walker and Brammer (2009, p.128) argued that “sustainable procurement refers to the act of integrating a concern for broader social and environmental impacts within procurement undertaken by government or public sector bodies.”

Meehan and Bryde (2011, p. 97) (DEFRE, 2011, p.97) regarded SPP as “the acquisition of goods and services in a way that ensures that there is the least impact on society and the environment throughout the full life cycle of the product.” Amann et al. (2014) used a general concept in SPP, which divided SPP into green public procurement (GPP) and socially responsible public procurement (SRPP). Over time, the definition of SPP in the literature gradually unified. Many scholars define SPP as the integration concerns of environmental, social, and economic issues when public procurement practitioners purchase goods, works, and services (Uttam and Le Lann Roos, 2015). They recommend carrying out the process of purchasing in a socially, economically, and environmentally responsible manner, with the ultimate goal of achieving sustainable development results (Walker, 2015; Witjes and Lozano, 2016; Leal Filho et al., 2019). In addition, to have a more standardized and recognized interpretation of SPP, many scholars have directly quoted the definition of SPP from the UN or EU as the starting point for their research content (Dupka et al., 2020; Mélon, 2020; Sönnichsen and Clement, 2020).

Through a review and clustering of the existing definitions of SPP, we can see that the main connotation and scope of SPP do not differ significantly although the explanations of SPP in research reports and academic literature are not entirely the same. This study adopts the 2017 definition of SPP by the UNEP as the conceptual basis for the design of indicators and subsequent assessment of SPP in China. According to the UNEP (2017, p.1), sustainable public procurement refers to a process whereby public organizations meet their needs for goods, services, works, and utilities in a way that achieves value for money on a whole life-cycle basis in terms of generating benefits not only to the organization but also to society and the economy, whilst significantly reducing negative impacts on the environment. The UNEP’s definition encompasses the three dimensions of SPP in its entirety and additionally embodies a comprehensive opinion of procurement practitioners and sustainability policymakers worldwide. So far, by combing and reviewing the definitions of SPP in practice and literature, we have established a recognized concept of SPP in this study. Meanwhile, we also recorded the classification and related keywords of SPP encapsulated in the definitions, which served as the basis for our subsequent assessment system design.

## The assessment of SPP

It is quite generally accepted that having a policy does not equate with implementation (Pressman and Wildavsky, 1973; Kristensen et al., 2021). An assessment system should be designed to learn how much SPP has actually been implemented in public procurement. Researchers have indeed worked toward this direction and established relevant assessment indicators or systems to assess SPP. Especially in recent years,

government data are more available with increased government transparency (Boeger, 2017), which makes it possible to assess sustainable development in the public sector.

One of the main research focuses of SPP is the measurement of SSCM, though some public sectors have not yet attended to these important aspects of SPP, possibly due to the very narrow public procurement function (without the awareness of SSCM). Many researchers endeavor to explore the assessment of a sustainable supply chain (Seuring and Müller, 2008; Schöggl et al., 2016), and the assessment methods include fuzzy logic (Erol et al., 2011; Wang and Chan, 2013), life cycle assessment (Cucchiella et al., 2013), analytical network process (Tseng and Geng, 2012; Zhou et al., 2012), interviews (Hoejmose et al., 2014), and empirical or case studies (Vlachos and Malindretos, 2012; Yang et al., 2013). As Grosvold et al. (2014) suggested, the relationship between management, measurement, and performance of sustainability in the supply chain should be evaluated across different countries. The importance of social and environmental management and measurement within public procurement processes should also not be neglected (Walker and Brammer, 2009).

The current research method used to analyze SPP implementation mostly adopts questionnaires and manual or expert reviews. The purchasing social responsibility (PSR) scale has long been employed for SPP investigation and framework surveys by using questionnaires (Carter and Jennings, 2004; Carter, 2005). The PSR scale identifies five dimensions of sustainable procurement—environment, human rights, safety, philanthropy, and diversity—and 14 items under different dimensions. Considering different countries’ actual situations and different evaluation items, many scholars have adopted a PSR scale. Along the line of the PSR scale, researchers explore the relevant dimensions of human rights and philanthropy (Etse et al., 2021) and procurement from SMEs and local suppliers (Walker and Brammer, 2012; McMurray et al., 2014; Islam et al., 2017a, 2017b). Although much of the extant literature has confirmed that the PSR scale is a reliable evaluation tool, a relatively limited number of items is covered by the scale itself, resulting in an incomplete assessment. In addition, given the expression of its evaluation items, it is usually necessary to introduce or train the interviewer in advance. Therefore, it is not applicable to studies that use procurement documents as a data source. Moreover, this method could also cause “self-selection” and a “low response rate” to the research findings to a certain extent (Walker et al., 2012). In addition, using interviews and surveys means that the data are perceived and not actual and one only measures how much SPP the respondent thinks there is, not how much there actually is.

In the literature that uses procurement documents as the data source, SPP assessment is mostly designed by expert groups or peer reviewers. These assessment items are based on the country’s reality or the research project (Mansi, 2015; Popovic et al., 2018; Bernal et al., 2019). When compared with the PSR

TABLE 1 Methods and scopes compared of the SPP studies.

	Method	Assessing items	Sample number	Research scope
Este et al., 2021	Questionnaire	16	76	Ghana, education sector and health sector
Walker and Brammer, 2012	Questionnaire	16	280	20 countries
McMurray et al., 2014	Questionnaire	16	127	Malaysia
Islam et al., 2017a	Questionnaire	16	202	Saudi Arabia
Islam et al., 2017b	Questionnaire	16	200	Saudi Arabia
Mansi, 2015	Manual or expert review	67	50 reports	India
Popovic et al., 2018	Manual or expert review	31	141 reports	Global
Montalbán-Domingo et al., 2018	Manual or expert review	22	451 tender documents	10 countries, construction industry
Braulio-Gonzalo and Bovea, 2020a	Manual or expert review	28	43 tender documents	Spain, furniture sector
Parikka-Alhola, 2008	Manual or expert review	44	31 tender documents	Finnish and Swedish, furniture sector
Grandia and Kruyen, 2020	Text-mining	89 sub-subcategories	28,452 procurement documents	Belgium, all sectors

scale, the evaluation indicators established this way have been greatly improved in quantity and classified in more detail. However, when assessing the implementation of SPP in procurement documents, manual or expert review is mostly adopted in the procurement document literature. Some authors have also identified limitations and problems with their studies (Mansi, 2015; Montalbán-Domingo et al., 2018; Braulio-Gonzalo and Bovea, 2020a). These research methods may constrain the scale of research samples to a certain extent, thus affecting the reliability of the study results. In addition, some authors established corresponding assessment systems for SPP within a particular industry or sector, such as the education and health sectors (Etse et al., 2021), the furniture sector (Parikka-Alhola, 2008; Braulio-Gonzalo and Bovea, 2020a), and the construction industry (Montalbán-Domingo et al., 2018). However, these indicators may be specific to a certain sector and may not necessarily be in line with the assessment of overall public procurement projects.

To compensate for the limitations of the extant literature and understand the actual implementation of SPP in practice, Grandia and Kruyen (2020) conducted a study on large-scale procurement notices in Belgium. Their research work established the full concept, ascertained the detailed operation of SPP, and quantitatively analyzed the implementation of SPP in the Belgium public sector by using text-mining techniques. They classified the operationalization of SPP in Belgium into seven categories and expanded it further into subcategories and sub-subcategories. These were verified by experts and focus groups to obtain a more comprehensive and complete assessment system. In the review and comparison of the literature we made in Table 1, we can see that this research strategy avoids the disadvantages of the research method and the limitation of the number of assessing items and samples. The SPP assessment system proposed by Grandia and Kruyen (2020) provides a valuable reference to subsequent research on this topic using big data and computer technology.

We respond to Grandia and Kruyen (2020) and refer to the assessment system of SPP therein. The reasons result from three folds: theoretically, this assessment framework is rich in content and in accord with the UNEP's three-dimension SPP definition. Operationally, their research method has been proven to be appropriate for our research with a large-scale procurement document. Lastly, the research strategy can avoid the pitfalls of measuring the implementation of SPP *via* surveys or interviews, allowing researchers to search for specific categories and to identify patterns in the data. As it does not depend on the memory or availability of actors, it also enables the assessment of the implementation of SPP even in older procurement documents, and is, therefore, able to present reliable assessments of the implementation of SPP and patterns therein.

## Methodology

### Assessment system in China

In the absence of a recognized Chinese policy concept and assessment system for SPP, this study adopts the UNEP's SPP definition as the starting point toward defining and assessing SPP in China as this definition is the most recognized and accepted interpretation of SPP in both academia and practice.

The study also refers to the assessment system of SPP proposed by Grandia and Kruyen (2020). However, given the different policy backgrounds and semantic environments between the two countries, we adjusted the Grandia and Kruyen (2020) SPP assessment system. First, China was found to operate the list management of energy-saving and environmental-labeling products for public procurement. The products included in the lists of energy-saving and environmental-labeling are preferentially and compulsorily purchased (Ministry of Finance, 2004, 2006). Therefore, for



example, in the main category—sustainable label—the original subcategories of “eco label,” “ethical trade label,” and “local brand” are substituted for two other subcategories: “product labeling” and “government procurement lists” to reflect the identification of the tenderer on whether the goods or services meet specific sustainability standards. Second, we add one more subcategory of poverty reduction under the main category of ethical trade to reflect the much more comprehensive poverty reduction practice in China (State Council of the PRC, 2018), including social and economic infrastructure development, industrial development in the targeted poverty regions, and labor participation for the targeted poverty population. Finally, considering the social and linguistic differences between the two countries, we also removed related expressions, such as “wrong labor” and “right labor” that do not exist in the Chinese context. The expressions of synonymy and different words in the two countries ensure correspondence and accuracy in subsequent assessments.

To better understand and improve the assessment systems of SPP, we also consistently reviewed SPP definitions from other international organizations and countries. We systematically clustered SPP assessment systems from development reports and academic pieces of literature. We also identified 19 national laws and 51 policies related to SPP in China and finally summarized all the keywords related to the connotation of SPP. At the same time, public procurement notices and documents on the website of Chinese Government Procurement (<http://www.ccg.gov.cn/>) were reviewed. This was done to identify related synonyms (e.g., waste management and garbage management), abbreviations (e.g., environmental protection and EP), substitutions (e.g., VOCs and volatile organic compounds), and related actual expressions. The relevant concepts and terms of SPP are covered as comprehensively and accurately as possible. To increase the robustness of the systems, the study obtained some experts' opinions in the field of public procurement in China (all of them have rich teaching and research or working experience in public procurement and sustainable development). These opinions have been incorporated into the design of the assessment systems of this study.

To sum it up, we classify SPP into seven main categories: environmentally friendly procurement, a circular economy, social returns on investment, ethical trade, SME-oriented public procurement, innovation-oriented public procurement, and a sustainable label. “Environmentally friendly public procurement,” also known as green public procurement, refers to procurement considering the environmental impact of works, goods, and services on production, consumption, and disposal. “Circular economy” means an economy that is restorative and regenerative by design and which aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles (ISO 20400, 2017). “Social return on investment” means creating

more employment opportunities for people who are disadvantaged within the labor market. When issuing purchase orders, public procurers can encourage or require contractors to employ vulnerable groups when implementing the contract (PIANOo, 2022). This study involves creating employment opportunities for the underprivileged, long-term unemployed, or disabled citizens through public procurement. “Ethical trade” is about having confidence that the products and services we buy have not been made at the expense of workers in global supply chains enjoying their rights (Ethical Trading Initiative, 2022). This study involves topics such as human rights, fair trade, poverty reduction, and labor conditions. “SME-oriented public procurement” refers to procurement in such a way that small and medium-sized entrepreneurs can supply them and aims to create more opportunities and profits for small and medium-sized entrepreneurs. “Innovation-oriented public procurement” refers to using sustainable procurement to stimulate innovation from the supply chains to gain greater shared value and generate new markets (ISO 20400, 2017). “Sustainable label” encompasses a wide range of sustainable labels and standards that may be specified when purchasing goods, services, or works. In the Chinese context, it mainly refers to the list of energy-saving and environmental-labeling required by the Chinese (Ministry of Finance, 2006). We also further develop 26 subcategories and 57 sub-subcategories corresponding to the main categories. A detailed overview of the main categories, subcategories, and sub-subcategories of SPP in China can be found in [Supplementary Appendix Table SB1](#).

## Data collection

We used a web crawler technique and collected all the publicly available tender documents by the central government in China during 2015–2020 as the research sample. The sample covers central government procurement by state organs such as the legislative, executive, and judicial branches of government and public institutions such as hospitals, universities, and schools, as defined by the Chinese Government Procurement Law (Cao, 2017). Considering the availability of samples, we collected the tender projects as the research sample. From a statistical point of view, the sample of tender projects can reflect the overall situation of government procurement because it is the most prevalent procurement method in Chinese government procurement in terms of both project value and number. The tender documents are the most appropriate sample for the purpose of the study as rules concerning major (sustainable) procurement decisions such as technical specification and its compliance, supplier qualification and selection, and awarding criteria are only provided in detail in tender documents rather than in the procurement notice, tenderer's submission documents, or contract. Lastly, the

government requirement in tender documents (what the public organization wants) can generally represent what is actually implemented (what governments are getting) as the bidder's submission documents must be responsive to the tender documents, specifically to the SPP terms and conditions. Therefore, it is also feasible to use tender documents as a proxy variable for assessing the actual implementation of SPP. The timespan for the data coverage of the research is set to be 6 years (2015–2020) as tender documents were only required to be made publicly accessible online since 2015, due to a new regulation (State Council of the PRC, 2015), and in early 2021, we started to conceptualize the research and collect data and build up the data bank. The timespan is also coincidentally consistent with that of Grandia and Kruyen (2020), making a subsequent exact benchmarking exercise viable.

We first used the web crawler technique to obtain 80,911 central-level public tender notices published on the Chinese Government Procurement Network (<http://www.ccgp.gov.cn/>) during 2015–2020. Next, we continued to use Python software to obtain the procurement notice attachments and stored them in a MySQL database. All the attached links were downloaded in batches; we tried to increase the number of samples in various ways, and the maximum proportion of the procurement documents finally obtained was 52% of all items. The problems in the download mainly result from four unavoidable and objective situations: 1) in actuality, some projects are not attached to procurement documents at all. 2) Some procurement documents are only accessible to a registered procurer or supplier. 3) Some procurement documents are encrypted. 4) The uploaded attachments are not the required procurement documents, but rather other documents such as the “award of contract,” “procurement list,” “tender invitation,” or “tender data sheet.” We finally obtained 42,369 tender documents over the 6 years.

## Data analysis

The sheer volume of procurement documents makes it not feasible to use the conventional and manual coding technique. Grandia and Kruyen (2020) pointed out a similar problem with their tender data and, therefore, opted to use a computer-assisted text-mining strategy to identify SPP in the procurement notices. Text-mining is an objective research method (Kobayashi et al., 2018) that can intelligently identify textual components in documents including articles, books, journals, and reports (Han et al., 2012). The authors, therefore, suggest further research into SPP implementation to use this research method to determine the actual implementation of SPP. Against this background, our current study also employs text-mining techniques with some adjustments.

In view of the need to search related SPP terms in the assessment system, we choose Pdfplumber to search for SPP

TABLE 2 SPP implementation in documents.

	Number <sup>a</sup>
SPP	34,561 (81.6%)
No SPP	7,808 (18.4%)

<sup>a</sup>Number = number of documents in which there is consideration for one or more (sub-) subcategories of the relevant main category.

TABLE 3 SPP main category implementation ( $n = 42,369$ ).

SPP main category	Number <sup>a</sup>
SME-oriented procurement	32,342
Environmentally friendly procurement	31,164
Social return on investment	22,762
Ethical trade	20,480
Sustainable label	19,694
Innovation-oriented procurement	14,785
Circular economy	9,727
Total	150,954

<sup>a</sup>Number = number of documents in which there is consideration for one or more (sub-) subcategories of the relevant main category.

items other than Elasticsearch used in the former research. Given that all the tender documents in China were written in Chinese, the built-in word segmentation in Elasticsearch is especially good at processing English words and numbers. Therefore, after converting all the obtained tender documents to pdf format, we directly used Pdfplumber in the Python software to search for SPP terms in the documents. Pdfplumber can convert the text in the pdf files and the relevant contents in the tables into strings and then use the search function to record the number of each term in the corresponding pdf file.

## Results and discussion

### Overall implementation of SPP

In 81.6% of all 42,369 procurement documents, at least one sub-subcategory of SPP was implemented (Table 2). This means that in most procurement documents, reference is made at least once to one or more sub-subcategories of sustainable procurement. The result is better than the level of implementation in terms of GPP found through interviews with Chinese government officials (Zhu et al., 2013) and could indicate that the social desirability bias caused by self-reported data in China may lead to the underestimation of the implementation of procurement sustainability.

SME-oriented procurement is the most frequently implemented main category of SPP (Table 3) with

TABLE 4 SPP main- and subcategory implementation ( $n = 42,369$ ).

SPP main category	SPP subcategory	Number <sup>a</sup>
SME-oriented procurement	SMEs	32,333
Environmentally friendly procurement	Consumption	28,672
Environmentally friendly procurement	General	28,436
Social return on investment	Distance to the labor market	22,545
Sustainable label	Government procurement lists	18,620
Innovation-oriented procurement	Innovation-oriented procurement	14,785
Ethical trade	Fair trade	14,594
Circular economy	Circular economy	9,727
Ethical trade	Labor conditions	9,259
Sustainable label	Product labeling	6,130
Ethical trade	Poverty reduction	4,855
Environmentally friendly procurement	Environmental pollution	1,433
Environmentally friendly procurement	Water	1,272
Environmentally friendly procurement	Energy generation	1,173
Environmentally friendly procurement	Food	888
Environmentally friendly procurement	Waste	855
Environmentally friendly procurement	Gasses	685
Social return on investment	Labor participation	645
Environmentally friendly procurement	Forests	439
Environmentally friendly procurement	Sustainable raw materials	369
Environmentally friendly procurement	Green energy	314
Environmentally friendly procurement	Transport	263
Environmentally friendly procurement	Material consumption	213
SME-oriented procurement	Local enterprises	86
Social return on investment	General social	39
Environmentally friendly procurement	Soil	37
Ethical trade	Acceptable wages	10
Ethical trade	Rights	2

<sup>a</sup>Number = number of documents in which there is consideration for one or more sub-subcategories of the relevant subcategory.

32,342 procurement documents implementing it, and a close runner-up is an environmentally friendly procurement. The lowest ranking is the circular economy with only 9,727 procurement documents implementing it. The second least implemented main category of SPP is innovation-oriented procurement.

If we zoom in at the level of the SPP subcategory (Table 4), SME-oriented procurement maintains its champion ranking as in the case of the main category. Environmentally friendly procurement in consumption and general are the two runners up with almost identical counts, indicating that there is a prevalence of environmental subcategories and its procurement is still at the core of SPP implementation. However, it is notable that some environmental subcategories vary sharply with some much less often implemented, such as sustainable energy (e.g., solar, water, and wind energy generation and consumption), transportation, and waste. This is remarkable as energy and

transportation are among the top sectors that produce the most carbon emission and are often at the heart of the discussion of sustainability and climate change policy (Dahlmann and Roehrich, 2019; The Climate Group, 2021; IEA, 2022; Sinha et al., 2022; Usman and Balsalobre-Lorente, 2022). It is also interesting to note that the subcategories of energy, transport, and waste are implemented less often than social subcategories such as distance to the labor market, labor conditions, and poverty reduction. Both the Chinese and Belgian cases indicate the requirement for a stronger linkage between procurement and energy and transport policy (and waste sector in the Chinese case) in the future. The case of these neglected or missing sectors might also indicate a negative connection between policy and implementation, the reason of which requires further exploration. Finally, in the main category of ethical trade, such as acceptable wages and rights, some subcategories score so remarkably low that it appears that they are hardly implemented in practice.



TABLE 5 Number of SPP sub-subcategories per procurement document.

From	Until	Number <sup>a</sup>
0	0	7,810
1	5	5,713
6	10	15,756
11	15	10,874
16	20	1,968
21	25	223
26	30	19
31	35	4
36	40	1
41	45	1

<sup>a</sup>Number = number of documents in which there is consideration for one or more (sub-) subcategories of the relevant main category.

The finding on the overall implementation in China confirms the prevalence of environmentally friendly procurement in practice in China and other jurisdictions where environmentally friendly procurement is most implemented, such as in France (Oruezabala and Rico, 2012), Saudi Arabia (Islam et al., 2017b), and Belgium (Grandia and Kruijen, 2020). But on the other hand, China seems to implement SME-oriented procurement most rigorously compared with other jurisdictions where a pro-SME procurement policy is also implemented, e.g., India (Mansi, 2015), Canada (Brammer and Walker, 2011), US (Stoffel et al., 2019), and Belgium (Grandia and Kruijen, 2020). For example, while SME-oriented procurement is the most frequently implemented main category and subcategory of SPP in China, the ranking of SME-oriented procurement in Belgium is substantially low at the level of both the main category (5th of the total 7) and subcategory (10th of the total 31) of SPP (Grandia and Kruijen, 2020).

The findings on the overall implementation in terms of the social dimension of SPP in China may also be benchmarked with those of Belgium by Grandia and Kruijen (2020). The two countries converge in certain aspects but diverge in others. Social SPP achieves a relatively high ranking at the main category level in both countries. It is also interesting to note that some social subcategories are even more often implemented than some important environmental indicators in both countries. But the two countries diverge in the priority of certain aspects of social policy. While Belgium pays much attention to the discussion of working conditions, China is more concerned with the distance to the labor market, such as promoting employment for the disabled and other disadvantaged groups and poverty reduction.

It is also interesting to note that in both China and Belgium, circular economy and innovation-oriented procurement rank the lowest. In China, circular economy is the least implemented main category of SPP. It is notable that innovation-oriented

TABLE 6 Co-occurrences of SPP main category.

	EF	CE	S	E	SME	I	SL
EF	1.00	—	—	—	—	—	—
CE	0.53	1.00	—	—	—	—	—
S	0.78	0.23	1.00	—	—	—	—
E	0.67	0.20	0.63	1.00	—	—	—
SME	0.92	0.46	0.95	0.65	1.00	—	—
I	0.51	0.31	0.28	0.27	0.59	1.00	—
SL	0.96	0.27	0.59	0.26	0.89	0.23	1.00

Note: EF = Environmentally friendly procurement; CE = Circular Economy; S = Social Return on Investment; E = Ethical Trade; SME = SME-oriented procurement; I = Innovation-oriented procurement; SL = Sustainable label.

procurement is least implemented in Belgium, while in China it is implemented the second to the least.

Last but not least, the aforementioned comparison must be qualified as the time span of the research samples collected are not entirely overlapped, as in the case of the studies in China and Belgium, and different methodologies are employed as in the case of other studies.

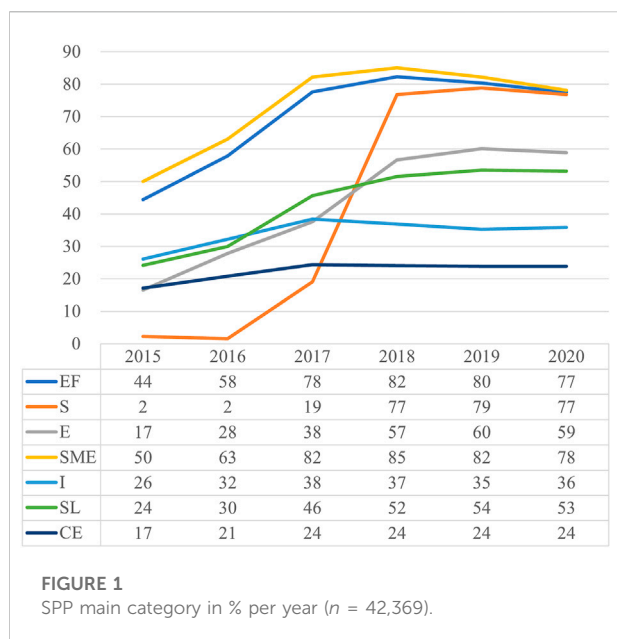
## Implementation patterns of SPP

### Category number in each document

As indicated earlier, 81.6% of documents implement at least one category of SPP. As seen from Table 5, of those documents that do implement SPP, each document implements on average 7.68 different sub-subcategories of SPP with a majority (63%) including 6–15 different sub-subcategories of SPP. It shows that in most cases, once a procurement implements SPP, it involves a wider variety of sub-subcategories of SPP. No document implemented more than 45 different sub-subcategories. However, more categories in a procurement project do not necessarily mean that it is more sustainable; fewer categories might signify that these projects have chosen to focus on one category of SPP and implement that in a more challenging and stricter manner.

### Co-occurrences of the SPP category

Given the dichotomous nature of our data—that is, 1 represents attention for an element of SPP and 0 represents the absence of attention—tetrachoric correlations were used to investigate the co-occurrence elements of SPP. On average, there is a correlation of about 0.31 between references to the elements of SPP at the level of sub-subcategories (SD = 0.024); a correlation of about 0.37 at the level of subcategories (SD = 0.056); and a correlation of about 0.65 at the level of the main categories (SD = 0.05). This means that procurers, once they implement sustainability in their projects, do not focus on one



particular subcategory only but simultaneously implement different subcategories from the main category.

It is also found in Table 6 that the two most relevant main categories are environmentally friendly procurement and sustainable label (a correlation of 0.96), which indicates that most projects implementing environmentally friendly procurement involve the implementation of sustainable labeling as well and the two main categories may be reinforcing each other to a certain extent. Social return on investment and SME-oriented procurement (a correlation of 0.95) also tend to be implemented jointly. In addition, we also found that the correlation between environmentally friendly procurement and SME-oriented procurement is above 0.9 as well. China has long implemented these two categories, and it appears that the implementation of one main category has also motivated the implementation of another main category to a certain extent. The cases seem to suggest that strong political commitments and clear operational rules play an important role in promoting sustainable procurement, indicating a positive connection between clear legal policy requirements and robust implementation.

### SPP and time trend

Though the Chinese GPL implemented a broad socio-economic procurement policy, the actual implementation of different categories of SPP has not been achieved all at one time but rather developed over time. For example, environmentally friendly and SME-oriented procurement has been implemented more than a decade but procurement for the benefit of the disabled group has been

TABLE 7 SPP main category in % by award method ( $n = 32,856$ ).

	EF	CE	S	E	SME	I	SL	Documents
MAT	90	28	67	59	95	43	57	31,816
Lowest price	81	23	49	68	75	38	63	1,040

Note: EF = Environmentally friendly procurement; CE = Circular Economy; S = Social Return on Investment; E = Ethical Trade; SME = SME-oriented procurement; I = Innovation-oriented procurement; SL = Sustainable label. Documents = Number of public procurement documents.

the most recent one (Ministry of Finance, 2017). We, therefore, wondered if the implementation of the different main categories had changed over time and what may contribute to the change.

We found in Figure 1 that the overall SPP implementation indicates a steady upward trend over the years. Among the main SPP categories, both SME-oriented procurement and environmentally friendly procurement start high from around 50% and rise remarkably to a higher and stable level of above 80% implementation.

We do see two major increases. The most impressive one is with social return on investment rising sharply from the lowest implementation level of 2% to a stable high level of almost 80% over the most recent three years. The remarkable growth of social return on investment can be attributed to the greater policy attention paid to development for the disabled and other disadvantaged groups (Ministry of Finance, 2017). Another major increase is with ethical trade rising from a relatively lower level of 17% to a higher and stable level of about 60% over the most recent 3 years, resulting from the attention of the recent poverty reduction policy (State Council of the PRC, 2018). The two major increases strongly indicate a substantial transformation of China's SPP toward social aspects of SPP in recent years, confirming the rigorous implementation of the highly-prioritized political philosophy and policy action of people-oriented development in China in the recent decade. The cases also seem to indicate a positive connection between clear legal policy requirements and robust implementation.

The main category with the lowest growth rate is the circular economy. After a relatively small increase in 2015 and 2016, it has become stable since 2014. All categories of SPP peak in 2018 and 2019 and seem to have a slight decline in 2020. The only notable exception is innovation-oriented procurement, which peaked and decreased earlier in 2017. However, it is encouraging to see that innovation-oriented procurement may be better implemented than expected in China as it maintains a relatively high level of implementation (between 30 and 38% implementation over most of the years) even at a time when the Chinese government still insisted on a decoupling policy between government procurement and innovation (State council of the PRC, 2016).

TABLE 8 SPP main category by average tender price × million CNY ( $n = 34,977$ ).

	EF	CE	S	E	SME	I	SL
SPP	51.30	144.28	62.08	11.23	49.77	9.44	73.47
No SPP	4.65	7.90	8.3	76.95	5.45	61.23	8.22

Note: EF = Environmentally friendly procurement; CE = Circular Economy; S = Social Return on Investment; E = Ethical Trade; SME = SME-oriented procurement; I = Innovation-oriented procurement; SL = Sustainable label. Documents = Number of public procurement documents.

## SPP and the award method

A total of 32,856 documents specified the award method: either the lowest price tender or the most advantageous tender (MAT—which is equivalent to the European concept of most economically advantageous tender, MEAT) (Cao, 2002). The results show that an overwhelmingly dominant share of documents (96.8%) is identified as implementing SPP by the award method of MAT (Table 7). This conforms to the common perception that MAT can accommodate more assessment criteria about sustainability than price and, thus, more prone to SPP. However, it is also interesting to note that even in the ones with the lowest price award method, there is a lot of attention paid to SPP.

This relationship between SPP and the award method is in sharp contrast with the finding in Belgium, which shows that more SPP were identified in notices with the lowest price as the award method than in notices with MEAT as the award method across almost all main categories of SPP (precisely 45% documents by MEAT and 55% documents by lowest price) (Grandia and Kruijen, 2020). In explaining the Belgian case, the authors think that it might be the case that opting for the lowest price award method is a way of dealing with the risk of higher prices for sustainable alternatives (Grandia and Kruijen, 2020). However, there might also be the case that with the increasing use of life cycle cost (LCC) and the widely available LCC tools in Europe, procurers are more likely to use the lowest price to award contracts in Belgium. If this is the case, there is a strong case for China to follow suit. However, more in-depth research is necessary to examine and explain why the implementation of SPP per award method differs so sharply between China and Belgium. Despite the difference, a similar observation can be made with regard to the relationship between the award method and SPP, i.e., both cases show that MAT/MEAT might not be a precondition for the implementation of SPP.

## SPP and tender price

We wonder whether the size of procurement matters in terms of SPP. A total of 34,977 documents reported procurement prices. We calculated the average price if a document

TABLE 9 SPP main category in % by type of contract ( $n = 33,926$ ).

	EF	CE	S	E	SME	I	SL	Documents
Works	82	25	38	80	50	29	29	1,577
Services	80	21	67	63	89	43	41	14,267
Goods	86	30	66	49	87	37	65	18,082

Note: EF = Environmentally friendly procurement; CE = Circular Economy; S = Social Return on Investment; E = Ethical Trade; SME = SME-oriented procurement; I = Innovation-oriented procurement; SL = Sustainable label. Documents = Number of public procurement documents.

implemented a specific SPP category and the average price if it did not (Table 8). Some salient differences are found between the price of documents with and without SPP implementation. In general, the documents that implemented SPP have a much higher price than documents without SPP categories, except for the case of ethical trade and innovation-oriented procurement.

It is interesting to see that the conclusions of China and Belgium are basically the same. The SPP category with the highest tender price is the circular economy and the lowest is innovation-oriented procurement (Grandia and Kruijen, 2020), which seems to suggest that the circular economy may be more applicable to larger procurement projects and innovation to smaller procurement projects. Specifically, the circular economy is not a frequently implemented category, but when it is implemented, it is in large (in terms of price) projects, meaning that its impact on procurement could still be quite big. The relationship may indicate that certain types of SPP might be considered more applicable or relevant for smaller or larger projects; however, it might also be the case that SPP projects are large because it is more expensive to implement SPP projects. The issue requires further enquiry.

## SPP and the type of contract

We are also curious about the actual implementation of SPP in different types of contracts (Table 9), notably, in works. On the one hand, public works projects tend to be large in value and, therefore, may exert more impact on the development of SPP; on the other hand, there was an ambiguity in the application of the GPL to works procurement, and with more coordination effort in 2015, there is a clear requirement for the application of policies under the GPL to government works procurement. However, the actual implementation of the policies under the GPL is not known.

A total of 33,926 projects contained information on the type of contract, with the majority of the SPP categories being implemented in the services and goods types. It is worth noting that a very high percentage of SPP in the ethical trade category was implemented for projects in works procurement. Therefore, implementing more SPP in works procurement

projects in the future is a challenge and task for Chinese government procurers.

## Conclusion, policy implications, and limitations

### Conclusion

Referring to the research questions raised earlier in this study, we can have the following conclusions and answers.

First, the UNEP's definition of SPP can be established as a recognized concept of SPP and operationalized with adaptation from [Grandia and Kruyen \(2020\)](#) to cover the full concept of SPP for the research of this study. This is particularly relevant to China where a clear and established SPP policy is not yet in place and has proved to be very valuable in accomplishing the detailed and precise benchmarking exercise in this research. Just as [Stoffel et al. \(2019, p.1\)](#) found, although there is no sign of comprehensive integration of all dimensions in SPP, there are developments toward the integration of the "missing" dimension in the respective. The adoption of the full concept of SPP can certainly help identify the "missing" dimension and improve the overall SPP policy and implementation.

Second, the actual implementation percentage of SPP is 82% in China. SME-oriented procurement is the most frequently implemented main category and subcategory of SPP and a close runner-up is environmentally friendly procurement. The lowest ranking is the circular economy and the second least implemented main category of SPP is innovation-oriented procurement. Some important environmental aspects of SPP are less often implemented than others, e.g., in the energy and transport sectors. This is especially the case where the subcategory environmental indicators of energy generation and consumption, gas, waste, and transport are implemented quite nominally relative to those best implemented environmental indicators. Social SPP achieves a relatively high ranking at the main category level, especially in the distance to the labor market, such as promoting employment for the disabled and other disadvantaged groups and poverty reduction. It is also interesting to note that some social subcategories such as distance to the labor market, labor conditions, and poverty reduction are even more often implemented than some important environmental indicators such as energy, transport, and waste.

Third, we also conclude that five patterns of SPP implementation can be identified. First, in most cases in China, once a procurement implements SPP, it involves a wider variety of sub-subcategories of SPP. Once procurers implement sustainability in their projects, they not only focus on one particular subcategory but also simultaneously implement different subcategories from the main category. Second, in China, the time trend indicates a steady upward trend over the years of the overall SPP implementation, especially in the case of SME-

oriented procurement and environmentally friendly procurement. However, two main categories of social SPP, i.e., social return on investment and ethical trade, have risen outstandingly over the most recent years, strongly indicating a substantial transformation of China's SPP toward a more balanced SPP policy implementation in recent years. Third, there appears to be a relationship between the contract price and the implementation of specific categories of SPP, notably, for example, a circular economy may be more applicable to larger procurement projects and innovation to smaller procurement projects. Fourth, a dominant share of documents (96.8%) was identified as implementing SPP by the award method of MAT in China, which is in sharp contrast with that of Belgium and other EU countries ([Renda et al., 2013](#); [ICLEI, 2016](#); [Grandia and Kruyen, 2020](#)) where more SPP is implemented by the award method of the lowest price. Fifth, the majority of the SPP categories were implemented in the services and goods rather than works in China.

Fourth, we observe convergence and divergences and strengths and weaknesses of SPP implementation when we compare our findings with previous research results worldwide, especially those from Belgium. The particular design of this research enables precise and meaningful comparison between the level of actual SPP implementation in China and Belgium. An exact and detailed comparison between China and Belgium is given in [Supplementary Appendix Table SC1](#).

In terms of environmental sustainability, our finding on the overall implementation in China confirms the prevalence of environmentally friendly procurement in practice in China and other jurisdictions. Environmentally friendly procurement ranks a champion position in the Belgium case and a very close runner-up to the champion position in China. The result is also consistent with findings from other countries, especially some member states in the EU, such as the Green-7 countries, which are global leaders in the environmental aspects of SPP ([Oruezabala and Rico, 2012](#); [Amann et al., 2014](#); [UNEP, 2017](#)). However, it is notable that both our study and that of [Grandia and Kruyen \(2020\)](#) found that some environmental subcategories vary sharply with some much less often implemented, such as sustainable energy (e.g., solar, water, and wind energy generation and consumption), transportation, and waste. This is remarkable as energy and transportation are among the top sectors that produce the most carbon emission and are often at the heart of the discussion of sustainability and climate change policy.

In terms of the social dimension of SPP, China and Belgium converge in certain aspects but diverge in others. Social SPP achieves a relatively high ranking at the main category level in both countries. But the two countries diverge in the priority of certain aspects of social policy. While Belgium pays much attention to the discussion of working conditions, China is more concerned with the distance to the labor market, such

as promoting employment for the disabled and other disadvantaged groups and poverty reduction. The Belgian case seems to be in line with other studies on developed countries (Islam et al., 2016; UNEP, 2017; Stoffel et al., 2019), which also emphasize working conditions and social security in social SPP. Findings from other developing countries seem to indicate a varied orientation. Although no literature specifically discusses SPP by category, we can find that most of these countries focus on human rights and security and hope to use public procurement to promote the fair and stable development of society (Etse, 2020; Stoffel et al., 2019).

In the economic dimension, one striking contrast between China and Belgium is the position of SME-oriented procurement. While SME-oriented procurement is the most frequently implemented main category and subcategory of SPP in China, the ranking of SME-oriented procurement in Belgium is substantially low at the level of both the main category (5th of the total 7) and subcategory (10th of the total 31) of SPP. The time trend again confirms the striking divergence between the two countries. However, interestingly, China and Belgium converge in circular economy and innovation-oriented procurement: both are the least implemented main category of SPP.

Some interesting convergence and divergence implementation patterns of SPP are also observed. For example, studies in both China and Belgium show a high correlation between environmentally friendly procurement and sustainable label, indicating that most projects implementing environmentally friendly procurement involve the implementation of the sustainable label as well, and the two main categories may reinforce each other to a certain extent. In terms of the relationship between the tender price and SPP implication, both studies seem to indicate that certain types of SPP might be considered more applicable or relevant for smaller or larger projects; for example, a circular economy may be more applicable to larger procurement projects. Interestingly, another study of ours (on completion) with the same methodology on public-private partnership (PPP) procurement (usually large investment projects) finds that a circular economy performs substantially well in terms of SPP implementation. But China and Belgium diverge sharply in terms of the relationship between SPP and the award method. While in China, most SPP is implemented by the award method of MAT, in Belgium, more SPP is implemented with the lowest price as the award method.

Fifth, we also explore the theoretical and practical complex connection between policies and implementation, though this is not the main purpose of the current research. We find that strong political commitments and clear rules play an important role in promoting sustainable procurement, for example, in the case of environmental-friendly procurement and sustainable label, SME-oriented procurement and certain aspects of social

procurement in China, indicating a positive connection between clear legal policy requirements and robust implementation. However, we also find neglected areas/aspects of SPP implementation in a positive policy environment, for example, the energy, transport, waste, circular economy, etc., which have a strong stake in carbon mitigation policy, indicating an obvious deviation of implementation from policy.

## Policy implications

The conclusion of this study also provides some valuable implications and useful suggestions for procurement practitioners and sustainability policymakers.

First, there is a need to establish a clear and comprehensive SPP policy. Just as Bratt et al. (2013) concluded, “if sustainability is not defined, strategic progress toward sustainability would be impossible.” The case of China might indicate that a higher level of actual SPP implementation may be achieved independent of a clear and established SPP policy. However, this does not diminish the value of such a policy but rather necessitates the establishment of a comprehensive and clear SPP policy. Though it is not intended to conduct a comprehensive study here on the contributing factors (and barriers) to the actual implementation of SPP, a clear correlation can be observed, indeed, between the long-established SME-oriented and environmentally friendly procurement policy and their higher level of actual implementation in China. The recent outstanding increase of certain social aspects of SPP is also attributable to the recent political emphasis on and regulatory requirement for the linkage between procurement and extraordinary poverty reduction efforts and support to disadvantaged groups such as the disabled. A clear and established SPP policy can help legitimize SPP (Wang et al., 2018; Jiménez et al., 2019) and enhance knowledge and raise awareness of SPP, which are identified as the main barriers to SPP implementation (Ruparathna and Hewage, 2014; Rosell, 2021). A clear policy framework can also help identify key sectors and aspects of SPP that might be overlooked and least implemented, so that SPP can realize its huge potential in mitigating climate change issues (UNEP, 2015; Vejaratnam et al., 2020). Therefore, it is strongly advisable that China, and perhaps other developing countries as well, establish a more comprehensive and clearer SPP policy supporting the UN’s SDGs.

Two, the value of assessing the actual implementation of SPP and benchmarking exercise is recognized. It is well-recognized that policy is one thing and implementation is another (Kristensen et al., 2021). In the absence of a clear established SPP policy, the requirement for such assessment may be more pressing as certain aspects of SPP may be implemented but others neglected. By further benchmarking with other experiences, we can further



identify convergence and divergence and strengths and weaknesses and motivate further policy development and research, without which the actual level of implementation might be underestimated and some important aspects of SPP might be overlooked.

Third, policymakers, practitioners, and academic researchers are strongly advised to attend to some of the coincidental common SPP “loopholes” found in China and other jurisdiction, i.e., some important sectors or aspects of SPP are much less implemented in practice (Grandia and Kruyen, 2020), such as energy and transport (also waste in China), circular economy, and innovation. It is imperative to have a stronger procurement linkage with these sectors in the context of climate change as they are at the core of discussion and policy development in mitigating carbon emissions (Doğan et al., 2022; Balsalobre-Lorente et al., 2022). It is also advisable that China motivates a clear and rigorous public procurement linkage with labor policies, such as workers’ basic rights, workplace safety and conditions that are protected by the Chinese Constitution Laws and Labor Laws, and forced labor which is a crime under the Chinese Criminal Law.

Fourth, the case of circular economy and SPP may deserve special policy attention as findings about both China and Belgium (Grandia and Kruyen, 2020) refer to the same conclusion that a circular economy may be more appropriately implemented in large projects. Interestingly, another of our recent (unpublished) studies on the Chinese PPP projects (which are generally large projects) shows that a circular economy has a much better performance in SPP implementation than conventional public procurement.

Fifth, the striking divergence of SPP implementation between China and Belgium in terms of the award method may be of great policy implication for China. It might be the case that a clear requirement for the LCC approach, plus, the availability of LCC tools has motivated more use of the lowest prices. Procurers may enjoy a better competitive edge in a price-only auction provided that they can easily convert SPP considerations to a price. Further enquiry into this issue seems to be imperative and has important policy implications, especially for China.

Lastly, Chinese policymakers should be mindful that SPP is strikingly less implemented in works than in goods and services. Works procurement has proved to be the key area to implement SPP, e.g., the construction industry (Fuentes-Bargues et al., 2017; Braulio-Gonzalo and Bovea, 2020b). The marginal level of SPP implementation in works in China requires further enquiry, but there seems to be a strong case that different laws governing government procurement be better coordinated.

## Limitations and future research

Although the design and research of this study were conducted systematically and rigorously, our study still has its limitations that provide directions and ideas for future research.

First, we only use the procurement documents by the central governments in this study. Future research could be extended to analyze public procurement projects at the regional/local level and the patterns of procurement implementation in different regions and sectors. In addition, the current research on Chinese SPP is also confined to data statistics of key works. Future research could focus more on assessing the degree of SPP integration (Da Ponte et al., 2020) to better understand how SPP is implemented throughout the procurement cycle. The current research only covers data from conventional procurement, and as PPP procurement is regulated separately in China and China has already developed into the world’s leading PPP market (World Bank, 2018), further research is required to assess the actual implementation of SPP in PPP projects, using the multi-dimensional concept of public-private partnership (Roehrich et al., 2014), and possibly, the same methodology to provide precise benchmarking exercises with the current study.

Second, in this study, we analyzed SPP as a whole to understand the actual implementation and development of SPP in China. Future research could focus on a certain dimension or a specific pattern of sustainable development by using the categories established in this study. For example, why does the relationship between SPP and the award method between China and Belgium, and possibly among other jurisdictions, diverge sharply and what we can learn from this for effective SPP implementation? Can we draw a principle that certain types or categories of SPP might be considered more applicable or relevant for certain types of projects (smaller/larger, or product/service etc.)? We have interesting preliminary findings but more evidence is certainly needed. In addition, the complex connection between policy and its implementation requires further exploration, especially for those neglected sectors or aspects of SPP found by Grandia and Kruyen (2020) and our study. Last but not least, the impact of different tender values and the companies successfully tendering for it (e.g. large vs. small companies) on SPP is also a valuable future research question, as this seems to make a difference in terms of realizing sustainable procurement in practice.

Last but not least, the particular design of this research enables a precise and detailed comparison between China and Belgium. Through our experience in this study, we would like to join Grandia and Kruyen (2020) to suggest similar research approaches used in our research for future research in other jurisdictions. With more research along the same line, the findings and observations found in our studies and in Grandia and Kruyen (2020) could be confirmed or tested, such as the impact of the award method, tender price, and contract type on SPP and the co-relations of different

categories of SPP to better inform policymakers and managers to more effectively implement SPP.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material; further inquiries can be directed to the corresponding author.

## Author contributions

Conceptualization, FC; methodology, FC and RL; software, RL; validation, XC; formal analysis, FC; supervision, FC; funding acquisition, XC. All authors have read and agreed to the published version of the manuscript.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fenvs.2022.947962/full#supplementary-material>

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