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Motivating green public procurement in China: An individual level perspective

Qinghua Zhu\textsuperscript{a}, Yong Geng\textsuperscript{b,\ast}, Joseph Sarkis\textsuperscript{c}

\textsuperscript{a}Institute of Eco-Planning and Development, Dalian University of Technology, Dalian 116024, PR China
\textsuperscript{b}Circular Economy and Industrial Ecology Research Group, Key Lab on Pollution Ecology and Environmental Engineering, Institute of Applied Ecology, Chinese Academy of Sciences (CAS), Shenyang, Liaoning Province 110016, PR China
\textsuperscript{c}Graduate School of Management, Clark University, Worcester, MA, USA

\textbf{Abstract}

Green public procurement (GPP) practices have been recognized as an effective policy tool for sustainable production and consumption. However, GPP practices adoption, especially in developing countries, is still an issue. Seeking to help understand these adoption issues, we develop a conceptual model which hypothesizes moderation effects of GPP knowledge on the relationships between GPP drivers and practices. Using primary data collected from 193 Chinese government officials, we find that regulations, rewards & incentive gains, and stakeholders exert pressure to motivate adoption of GPP practices. Knowledge of GPP regulations, responsibilities and experiences in developed countries is found to be limited. The study also found that voluntary regulations may actually be demotivating GPP practices. This study contributes to further theoretical and practical understanding of GPP practices. The findings can be helpful for policy makers, especially those in developing countries, to establish promotion and diffusion mechanisms for GPP practices as an important sustainable development tool.

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1. Introduction

Developed countries spend over 10\% of gross domestic product on their public procurement. Globally over six trillion US dollars were spent on public procurement in 2011. This purchasing magnitude can prove to be a significant policy instrument. Green public procurement (GPP) is one approach to further environmental policy (\textsuperscript{}Testa\textsuperscript{et al.}, 2012). GPP can be defined as a method to reduce environmental impact of purchased products through their whole life cycles by encouraging manufacturers to implement environmentally friendly product design and production (\textsuperscript{}Parikka-Alhola, 2008) through public purchasing effort. In this way GPP has been recognized as an effective way to develop capacity for green supplies and markets (\textsuperscript{}Ho\textsuperscript{et al.}, 2010). In addition to reducing governmental agencies’ social and environmental footprints, GPP practices have been found to stimulate sustainable behaviors in the private sector (\textsuperscript{}Brammer and Walker, 2011). Given the socio-economic breadth of this purchasing influence, GPP has been highlighted internationally (\textsuperscript{}Nissinen\textsuperscript{et al.}, 2009; \textsuperscript{}Testa\textsuperscript{et al.}, 2012; \textsuperscript{}Varnas\textsuperscript{et al.}, 2009).

China has become one of the global leaders in public procurement. In 2011, the total amount of public procurement was over RMB 5 trillion (about 762.5 billion US dollars) including administrative expenditures, education, health, public housing, transportation and energy (\textsuperscript{}Zhong, 2012). As a result, even in a recessionary period, rapid economic growth and industrialization, with commensurate environmental degradation, has made GPP critical in China’s development. Although a planned economy, with government a critical part of all aspects of economic and social development, barriers to GPP in China still exist. For example, unclear regulatory requirements, cost for GPP, and low environmental awareness by procurement personnel have been observed to hinder GPP practices (\textsuperscript{}Geng and Doberstein, 2008). Adopting developed countries’ practices, China has proactively sought implementation of GPP since 2004. Yet, Chinese governments still find effective GPP promotion a major challenge (\textsuperscript{}Wang\textsuperscript{et al.}, 2011).

Although GPP is gaining increased attention, studies on GPP practices are still limited, especially in comparison to private sector green purchasing. Most GPP studies are qualitative with a descriptive focus (\textsuperscript{}Ho\textsuperscript{et al.}, 2010; \textsuperscript{}Preuss and Walker, 2011), and a few quantitative survey-based studies (\textsuperscript{}Nissinen\textsuperscript{et al.}, 2009; \textsuperscript{}Walker and Brammer, 2009) are primarily on developed country practices. Broad-based empirical studies have only started to gain traction in this field.
One additional area of topical concern that has seen even less investigation is that of individual level analysis of GPP practices. Changing individual behaviors was identified as a key factor to implement GPP practices successfully (Meehan and Bryde, 2011). Influencing and motivating individual officials and personnel to implement GPP practices requires further research. In this study, we initially develop a conceptual model to examine if and how certain pressures and drivers, especially external ones, and GPP-related knowledge can increase GPP practices among individual officials.

Using data from a Chinese municipality we identify constructs for GPP practices (general products and service preference, green logistics, and green supplier monitoring) and drivers (regulations, rewards and incentive gains, and non-regulatory stakeholders) as well as their relationships. Moderation effects of individual GPP knowledge a third construct (defined by knowledge of detail regulatory requirements, responsibilities, and experiences in developed countries) are also examined. Our findings provide policy implications on how to better promote GPP practices, especially in the Chinese context. The implications are generalizable to other country contexts but limitations to the generalizations may occur to cultural factors that must be considered.

This study’s contributions include developing a conceptual model for GPP practices motivation. The conceptual model together with developed items on GPP pressures and drivers, and GPP-related knowledge and practices extends theoretical development for GPP practices. We also identify moderation effects of GPP-related knowledge on the relationship between GPP pressure and/or drivers and GPP practices adoption. The results provide practical and research implications that set the stage for additional studies, studies that can also be applied to other country contexts.

To achieve our research goals, we provide a theoretical foundation and hypotheses in Section 2. In Section 3, the methodological discussion details aspects of the sample and statistical analysis which we will use to evaluate the hypotheses. The results and discussions on the findings of relationships among pressure/drivers and GPP practices, and moderation effects of GPP-related knowledge are discussed in Section 4. Our final section summarizes our work while identifying future research directions.

2. Literature review and hypotheses

Environmental management practices such as GPP can improve both environmental and economic performance (Schaltegger and Synnestvedt, 2002). To examine GPP practices motivation, we first introduce the theoretical framework (see Fig. 1). External pressure such as from regulations can stimulate GPP practices while officials need tools and knowledge to effectively implement GPP practices (Testa et al., 2012). In this model, we posit that various drivers and pressures can motivate adoption of GPP practices while GPP knowledge moderates this motivation.

GPP practices can be defined as integrating environmental concerns into public procurement processes (Bolton, 2008). Thus, the GPP practices construct in this paper includes green products and service preference (GP), green logistics (GL) and green supplier monitoring (GS). Drivers can derive from regulations, non-governmental stakeholders and rewards & incentive gains. Knowledge, as a construct, can include knowledge about detailed regulatory requirements, responsibilities and experiences of developed country practices. Additional details on factor development will be introduced in the next subsections, and construct operationalization will be presented in the methodology section.

2.1. GPP practices at the individual level

The first dimension of GPP practices is green product or services preference (GP). One example of GPP practices is to include environmental indicators for tenders (Nissinen et al., 2009). Policies on GPP aim to reduce whole life cycle environmental impacts of services and products throughout their whole life cycle (Tarantini et al., 2011). Thus, GPP practices need to consider environmental burdens related to goods production, use as well as treatment or disposal of used products. This life cycle perspective is not always easy to evaluate in true procurement situations, but some form of auditing or eco-labeling may be appropriate. Public and government procurement staff, especially within developing countries and at the municipal governmental level, typically do not have the resources or expertise to judge the greenness of each product or service, making the use of various indicators and labels necessary.

The second dimension of GPP practices is green logistics. Similar to green purchasing experiences in leading companies (Niwa, 2009), GPP practices can require suppliers to make efforts to reduce environmental impacts in their logistics activities such as using less energy and resources and more environmentally friendly packaging and transport. For example, a related GPP logistics practice is a ‘buy-local’ effort to shorten transportation based environmental impact (Otsuki, 2011).

Supplier monitoring using environmental criteria (GS) is another important dimension for GPP practices (Bala et al., 2008; Wan and Lu, 2009). Such GPP practices can range from simply choosing suppliers with ISO 14001 certification to auditing suppliers evaluating actual environmental performance records including fines and penalties (Humphreys et al., 2003; Seuring and Muller, 2008). Moreover, officials may even examine internal energy saving and pollution reduction practices and records to determine the relative proactiveness of supplier environmental practices. The use of supplier assessment instruments and questionnaires may also be completed. There may be some overlap with the other practices in this category, but it can encompass supplier characteristics that are not necessarily included in product or logistics dimensions. Alternatively, the process of supplier selection does not necessarily include environmental criteria, even though there might be some purchasing of products and services, and expectations of greener logistics from suppliers.

2.2. Drivers for GPP practices

The literature has identified a number of potential drivers that will cause organizations, in general, to adopt various green practices (Wu et al., 2012; Zhu et al., 2012, 2011b). These same drivers can also influence individuals within organizations. We are focusing primarily on extra-organizational drivers. Some of these external major pressures and drivers are now identified.

Regulatory requirements are key motivators for GPP practices adoption (Davies, 2011). One difference between public and private procurement is that public procurement will need to explicitly
consider regulatory requirements and limitations (Lian, 2004).
There are multiple examples of such regulations and pressures. For
example, experiences in the European Union show that the existing
regulations support public authorities to develop GPP strategies
(Testa et al., 2012). Developed countries such as the UK have taken
the leading role in encouraging GPP practices through legislation
(Thomson and Jackson, 2007). China has also enacted laws and
regulations related to GPP practices. For example, as early as June
29, 2002, the Law on Government Procurement for the People's
Republic of China was introduced, and eventually enacted on
January 1, 2003, has made a general requirement that government
procurement be environmentally friendly. Based on this law,
provinces and municipalities have also developed regulations and
policies which have promoted GPP practices in China (Geng and
Doberstein, 2008).

Cost of greener products can be a barrier for governments in
both developed (Walker and Brammer, 2009) and developing China
(Geng and Doberstein, 2008) countries. Similar to green purchasing
by a company (Zsidisin and Sifred, 2001), cost is a big barrier for
green procurement. However, GPP as an environmental policy en-
courages government agents to purchase green products even if the
cost is higher than non-green alternatives (Marron, 1997), but this
is not true in many cases where local and governmental ordinances
require lowest price bid selection. In response to potential cost
differentials the Chinese central government has incorporated
preferential economic-based policies relying on subsidies to pro-
omote GPP practices (Xie, 2009). For example, in 2009, the central
government provided price subsidies for public offices or organi-
zation that purchased green vehicles. These economic subsidies are
10% for vehicles with an overall environmental label (assumed to be
100% environmentally sound), 5% for those with over 50% eco-
labeling parts, and 1% for those with less than 50% eco-labeling
parts. For furniture, IT and engineering products, the central gov-
ernment included environmental indicators for bids, and this
approach could also be viewed as a market or economic subsidy,
which gives a slight favor to procurement of greener products, all
else being equal.

Pressures from non-governmental stakeholders such as non-
governmental organizations (NGOs), media and the public can
promote GPP practices. In developed countries, non-governmental
organizations have played important roles related to monitoring
and promoting environmental management within their govern-
ments (Vigerstol and Aukema, 2011). In China environmental NGOs
have limited but increasing influence (Sarkis et al., 2011). Informa-
tion about green procurement has frequently appeared in newspa-
pers, magazines and other media in developed countries such as
Japan (Kusahara, 1999). The use of media, as a stakeholder, to raise
awareness is helpful for promoting GPP practices. In addition to
media, public attention and support are important for governmental
environmental programs (Ribeiro and Srisuwan, 2005).

Based on the discussions above, we put forward three related,
but separate hypotheses:

**Hypothesis 1a.** Government green procurement practices are
positively associated with regulatory drivers.

**Hypothesis 1b.** Government green procurement practices are
positively associated with rewards and incentive drivers.

**Hypothesis 1c.** Government green procurement practices are
positively associated with non-governmental stakeholders' drivers.

2.3. **Moderation effects of GPP-related knowledge**

Motivators exist to influence the adoption of GPP under certain
pressures or drivers. The likelihood of adopting practices will be
dependent on various personal, contextual factors and barriers,
even for important regulatory policies. Sometimes these contextual
factors will be enablers in the implementation of certain organi-
zational practices, the lack of enablers may lessen adoption.

Understanding detailed regulatory requirements are an impor-
tant part of GPP practices and their adoption or implementation
(Michelsen and de Boer, 2009). Without a deeper knowledge of the
regulation logic and purpose, managers and personnel may view
them as ‘unnecessary’ bureaucratic red tape that is difficult to
comprehend. Part of building this knowledge is through contextual
training that describes a broader, clearer picture of why GPP is
necessary. For example, in the UK, government training programs
targeting government procurement professionals are used to help
them understand GPP-related requirements under the European
Commission Law (Thomson and Jackson, 2007). These require-
ments may actually be complex and nuanced and this training
can provide clarity to requirements typically written in legalese
that a layperson would find difficult to interpret. Simple and clear
information to help procurement function employees understand
GPP practices has been found to increase willingness to implement
GPP practices (Faith-Ell et al., 2006).

Clearly identifying products or materials that would fit within
the environmentally acceptable (green) domain can help build
knowledge of GPP practices. The State of California in one example
developed a list of recommended product brands. This listing is
information that helped ease the adoption of GPP practices
(Swanson et al., 2005). Alternatively, it has been found (especially
in China) that lowered environmental knowledge of regulations has
been a barrier for government procurement persons to implement
GPP practices (Geng and Doberstein, 2008).

Besides alleviating environmental impacts, governments can
take responsibility in diffusing their environmental concerns and
practices to the private sector or individuals through their GPP ef-
forts (Brammer and Walker, 2011). Similar to environmental pur-
chasing among companies, knowledge acquisition and learning can
help governmental staff to improve performance through GPP
practices (Carter, 2005; Carter et al., 2000). Thus, this broader
knowledge of government’s role as a diffusion mechanism for
greening supply chains by government personnel can facilitate
environmental concerns into their procurement practices.

Another consideration is the possibility of innovation diffusion
from more developed regions of the world to less developed re-

gions. It can be argued that China can learn from developed
countries to promote GPP practices (Zhang et al., 2011). This type of
innovation knowledge diffusion has occurred in a number of ways
and topics, especially from a legitimation perspective. For example,
international organizations such as the United Nations have tried to
diffuse experiences of innovative practices in developed countries
to developing countries such as China through a variety of training
programs (Facon et al., 2008). At the same time, China also jointly
developed training programs with developed countries for capacity
building, sending out government employees and other citizens
abroad (Kreutzer et al., 2006) or inviting international experts to
train domestic citizens (Edwards and Roolofs, 2006). Similar
training programs among Chinese officials have been implemented
for GPP practices. Thus, government agents’ knowledge of experi-
ences in developed countries can help Chinese government
agencies and individuals to promote GPP practices more effectively
and efficiently.

With improved knowledge including knowledge of GPP related
detailed regulatory requirements, individual responsibilities as
well as regulations and policies observed from developed coun-
tries, we believe individual government representatives will tend
to be more proactive in implementing GPP practices when faced
with external pressures.
Using this background, we put forward three hypotheses focusing on the moderation effect between GPP drivers/motivators and GPP practices adoption:

**Hypothesis 2a.** GPP drivers will have a stronger relationship with government green procurement practices adoption when there is a greater knowledge of related regulations by government agency procurement personnel.

**Hypothesis 2b.** GPP drivers will have a stronger relationship with government green procurement practices adoption when there is a greater knowledge of related responsibilities by government agency procurement personnel.

**Hypothesis 2c.** GPP drivers will have a stronger relationship with government green procurement practices adoption when there is a greater knowledge of GPP experiences in developed countries.

### 3. Methodology

In this section we provide an overview of the instrument design, operationalization of the constructs, sample characteristics, descriptive statistics and initial construct reliabilities using exploratory factor analysis.

#### 3.1. Questionnaire development and samples

**3.1.1. Questionnaire development**

Based on a literature review of the GPP literature as well as interviews with 10 officials, five from the Shenyang Finance Bureau and five the Shenyang Environmental Protection Bureau, we developed a questionnaire for the GPP practices, pressures and knowledge constructs.

GPP practices need to consider environmental impacts of products and services life cycles (Tarantini et al., 2011). To capture this construct we include 10 items on resource savings and emission reductions associated with the procured product or services from a life cycle thinking perspective. Information concerning a product materials’ environmental sustainability is incorporated. Environmentally-oriented process items such as disassembling ease of end-of-life products furnished by the supplier are also included in the instrument.

Similar to private organizations and their supply chains, green logistics is an important aspect of GPP practices (Niwa, 2009). We include seven items to measure the green logistics construct. Given that GPP is dependent on overall supply chain management (Meehan and Bryde, 2011), the supplier selection process and its characteristics are important elements of GPP practices (Bala et al., 2008; Wan and Lu, 2009). We introduce five measurement items for supplier monitoring within the green procurement construct. The 22 specific questionnaire items measuring these constructs are shown in Table 1. For each item, we ask respondents about the level of implementation for each item (since these are GPP practices). We utilized a five-point Likert-type scale, ranging from “1 = never considered” to “5 = full implementation”.

Laws and regulations can be effective motivational pressures for GPP practices adoption (Davies, 2011). China has introduced a series of regulations related to GPP (Davies, 2011). To capture this motivational construct nine questionnaire items to determine the level of government procurement personnel pressure from these regulations are included.

A survey in the UK identified that economic barriers (costs) represent a major barrier for GPP (Walker and Brammer, 2009). Similarly, high cost is one of the key barriers for implementing GPP practices due to a limited public budget in China as a developing country (Geng and Doberstein, 2008). Considering the economic situation in China, we developed 4 items related to rewards and incentive drivers to help measure this construct. We have included both potential cost saving of products’ whole life cycles and financial support for GPP practices.

Pressure from non-governmental stakeholders such as NGOs (Vigerstol and Aukema, 2011), the public and media (Ribeiro and Srisuwans, 2005) can motivate GPP practices adoption. Four items to measure non-governmental stakeholder influence are introduced. Details of the 19 items for the three motivation constructs are summarized in Table 2. We sought to capture each respondent’s perceived level of importance from each motivational driver item using a five-point Likert-type scale, with a range from “1 = not important at all” to “5 = extremely important”.

In addition to drivers, building necessary knowledge capacity can aid or further support motivation to adopt GPP practices (Michelsen and De Boer, 2009). One of the big concerns in adoption of GPP in China is lack of clarity in indicators and regulatory requirements (Geng and Doberstein, 2008). For the level of knowledge of regulations construct, we developed 7 question items,
specifically asking the degree of respondents’ knowledge of the regulations. Governments can play a large role in promoting environmental practices by product producers, especially for small and medium-sized producers \cite{Walker_and_Preuss_2008}. Thus, four questions concerning regulatory subsidies and tax incentives for green product development, production and consumption are introduced.

China has developed training programs to learn about emergent innovative green practices from developed countries \cite{Kreutzer_et_al._2006;_Edwards_and_Roeolfs_2006}. China has also sent officials abroad to gain knowledge. Another program introduced four questions about knowledge of GPP practices by product producers, especially for small and medium-sized producers. Thus, four questions concerning regulatory subsidies and tax incentives for green product development, production and consumption are introduced.

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3.1.2. Samples

Our study targets government officials at the municipal governmental level. We chose Shenyang, China, the municipal capital of Liaoning Province for data collection. Shenyang was chosen for several reasons. First, Shenyang is one of the most important industrial cities in China, containing diversified heavy industrial sectors. Located in the central part of Liaoning province in northeast China, Shenyang is the largest city in northeast China and has a total population of over eight million people. Shenyang serves as the regional political and economic center in northeast China and has a great impact on many neighboring cities and provincial operations.

Second, Shenyang was selected by the central government of China as the only national environmental construction model city in April, 2009. In order to support its implementation, the Ministry of Environmental Protection of China (MEP) signed an overall agreement with the Ministry of Environment of Japan (MOE) in June 2009 to support a Shenyang-Kawasaki (Shenyang’s sister city in Japan) circular economy collaboration so that advanced environmental protection measures and technologies can be transferred to Shenyang, including GPP practices. This characteristic of Shenyang makes green procurement by its government agencies an even more important practice than a typical Chinese municipality due to its ‘ecological’ visibility. In addition, the Ministry of Science

<table>
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<td>* Rotation converged in 5 iterations.</td>
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and Technology (MOST) of China selected three urban districts of Shenyang (Tiexi, Heping and Shenbei) as national sustainable development demonstration areas in 2009 and 2010, respectively. These programs provided substantial opportunities for municipal district government officials to learn best environmental practices from other regions of China and the world.

Given this situation and attention, two urban districts (Heping and Shenbei) in Shenyang were selected as the study areas. To ease data acquisition, the research team and the two district governments established a close relationship so that the respondents can better understand the purpose and targets of this investigation. Similar to a city government, a district government is composed of various administrative bureaus, such as a finance bureau and an environmental protection bureau. Each district is represented by 30–35 bureaus.

In order to facilitate survey dissemination and collection, the science and technology bureaus within the Heping and Shenbei district governments were assigned to be in charge of this project. With their endorsement and support the research team obtained data and information from these two districts. There was no observed evidence that the leadership in the investigated units made any effort to affect the outcomes of this investigation. All participants were informed that all data collected were solely for academic purposes and would remain strictly confidential. This measure helped to guarantee a more open and unbiased result. Government officials were quite aware of the importance of these findings for programmatic advancement related to greening governmental practices.

In order to receive more holistic insights from all the bureaus, we sought to have three questionnaires from each administrative bureau within these two districts. Both districts have 35 administrative bureaus, thus a total of 210 officials was sought. The science and technology bureaus in both districts sent out and collected the questionnaires. Prior to the surveys, a brief session and several formal workshops were hosted by the research team so that the surveys could probe respondents for greater clarity in answers and consistency in relation to the objectives of the questions. In the end, 193 officials returned the questionnaires, providing an overall response rate of 87.7%.

To appreciate the value of this investigation, one needs to understand the general difficulties of investigating government officials in China. The government and its personnel are very apprehensive about going on the record for almost any type of specific practice question. There is a substantial concern that results may be used as a basis for criticizing Chinese government practices. This situation indicates that successfully conducting these surveys without the endorsement, support, and collaboration of the government units concerned is very improbable. Consequently, such investigations represent a rare opportunity for examining officials’ attitudes to GPP (or any practice) within China. The results can help identify the key barriers for the implementation of GPP. In addition, respondents were promised anonymity, and thus responses have been pooled to further provide respondent confidentiality.

3.2. Factor analysis

As one of the first studies on GPP practices from an individual perspective, we develop dimensions and items based on both a literature review of the public procurement literature and officials’ opinions. Given the novelty of this work, exploratory factor analysis (EFA) is used to identify the theoretical dimensions (factors) of the GPP practices, pressures/drivers, and knowledge constructs. The maximum likelihood method with varimax rotation was used to extract the factors. Both the scree test and initial eigenvalue test (eigenvalues > 1) suggested three meaningful factors each to characterize GPP practices, pressures/drivers and knowledge. The three GPP practices factors explain 71.5% of the inherent variation, while the three factors for causing pressures/drivers and GPP-related knowledge explain 75.5% and 75.1% of the variation, respectively. According to the items within each factor, we label the three GPP practices factors, green products and service preference (GP), green logistics (GL) and green supplier monitoring (GS); the three drivers/pressures motivation factors are labeled regulatory, rewards & incentive, and non-governmental stakeholder; and the three knowledge factors are labeled knowledge on regulations, responsibilities and experiences in developed countries.

The results of a reliability test and an item-total correlation analysis show that the derived factors are reliable. The reliability coefficient alpha values of the three factors for GPP practices are .94 for GP, .91 for GL, and .95 for GS, exceeding the benchmark value of .70 for exploratory research (Nunnally and Bernstein, 1994). All item-total correlation coefficients are also high, ranging from .61 to .81 for GP, from .68 to .82 for GL, and from .74 to .87 for GS.

The reliability coefficient alpha values of the three drivers/pressures motivation factors from regulations, rewards & incentive and non-governmental stakeholders have alpha values of .97, .92 and .93, respectively. The item-total correlation coefficients range from .78 to .89, from .74 to .83, and from .77 to .83, respectively. Alpha values for knowledge of regulations, responsibilities and experiences in developed countries are .92, .92 and .91, respectively. The item-total correlation coefficients range from .68 to .82 for knowledge of regulations, from .76 to .83 for knowledge of responsibilities, and from .74 to .82 for knowledge of experiences in developed countries, respectively.

4. Findings and discussions

4.1. General descriptive statistical results

General descriptive statistical results are summarized in Table 4. Mean values for the three GPP practices factors are relatively low, they are, 3.25 for GP, 3.06 for GL and 3.15 for GS, respectively. These results show that most officials are at the early planning stages for implementing GPP practices.

GPP motivational drivers are perceived as generally strong. The regulatory drivers factor has the highest mean value of 4.16, which means that officials on average feel significant pressure from GPP-related regulations. Rewards and incentive drivers have the second highest mean value of 4.00, which is consistent with a previous study that identified cost as a key barrier for GPP practices in China (Geng and Doberstein, 2008). The factor of non-governmental stakeholder drivers has a relatively lower mean value of 3.81. These results may be due to low stakeholder power from NGOs, media and the public for environmental protection in China (Tang et al., 2010).

GPP knowledge was found to be very low. The three factors have mean values between 2.24 and 2.89. These results are evidence that Chinese officials have only heard about GPP related regulations, responsibilities and experiences in developed countries but have few details.

These results are consistent with comments made by official staff in some personal, informal interviews. These staff indicated that they have sought to implement GPP practices mainly in response to increasing governmental and regulatory pressure. China has three laws (a Government Procurement Law, the Circular Economy Promotion Law, and the Energy Saving Law) which stipulate GPP related requirements. The State Council, Ministry of Finance, Ministry of Environmental Protection and National Development and Reform Commission have each developed agency level GPP requirements based on the three laws. In
compliance with these national level regulations, each province and municipality has also developed their own regulations and policies to promote GPP practices. However, these lower level governmental staff typically lack of knowledge and clear guidelines on how to implement GPP practices.

4.2. Results of moderation effects

To test the moderating effect of GPP-related knowledge on the GPP drivers-practices relationship, we followed the procedures developed by methodologists (Jaccard et al., 1990) and which were used in related research (Zhu and Sarkis, 2007). We analyzed the moderating effect in three steps (see in Tables 5–7). First, we entered the three GPP drivers factors as the first block. Second, we entered one moderator — one factor of GPP-related knowledge as a block, for example, knowledge of regulations in Table 5. Finally, we entered three interaction terms of GPP drivers and knowledge as the last block. We can conclude a moderating effect exists by evaluating the results in Step 3, either individually with significant values of betas, or collectively with a significant change in the F value (Dean and Snell, 1991).

To mitigate potential issues of multicollinearity within the moderation effect test, we employed a “centering” technique to get deviation scores for each predictor factor and for three moderating factors (Jaccard et al., 1990; Zhu and Sarkis, 2007; Zhu et al., 2011a). The variance inflation factors (VIF), with values close to 1.00, are within an acceptable range for our regression analyses.

4.3. Results discussion on hypotheses

4.3.1. Discussions on direct effects between GPP drivers and practices

Using Tables 5–7, we can observe that regulatory drivers have significant positive betas for each of the three GPP practices. These results strongly support Hypothesis 1a. That is, regulations are important for helping to motivate and promote GPP practices (Wedin, 2009). The Chinese government has paid special attention to incorporating environmental considerations into government procurement practices in response to increasing environmental pressures, which is evidenced by enactment of the Law on Government Procurement on January 1, 2003. For instance, former state environmental protection administration (SEPA, now reorganized as the Ministry of Environmental Protection) released environmental labeling standards in 56 industrial sectors so that procurement agencies can identify and seek green choices. Another example is a joint regulation released by the Ministry of Finance and the National Development and Reform Commission (NDRC, a ministry level agency) in 2004 requiring all governmental agencies to make energy-saving products a priority in their procurement lists. They requested that all the governmental agencies, including national, provincial, and local levels, to implement GPP beginning in 2005 (Geng and Doberstein, 2008). International policies such as the Governmental Purchasing Agreement encourage but do not require GPP practices while many of these policies are part of current Chinese policies which are made compulsory (Qiao and Wang, 2011). Our statistical results support that these Chinese regulations have exerted pressures on governmental officials to adopt GPP practices.

Rewards and incentive drivers, see Tables 5–7, show no significant results with two minor exceptions in the three methodological steps. These weak results do not substantially support Hypothesis 1b. The only two significant exceptions in this direct relationship between rewards & incentive drivers and adoption of GPP practices are for significantly negative beta scores (−.203 and −.178) for the third step for GS practices in Tables 5 and 7. Greater financial support and incentives do not relate to greater GPP or GL practices adoption. In fact, these greater incentives may cause some government officials to be even more reluctant to integrate

### Table 4

Descriptive statistics of green public procurement practices, drivers and knowledge.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPP practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green products and service</td>
<td>1.00</td>
<td>5.00</td>
<td>3.25</td>
<td>.88</td>
</tr>
<tr>
<td>Green logistics</td>
<td>1.00</td>
<td>5.00</td>
<td>3.06</td>
<td>.94</td>
</tr>
<tr>
<td>Green supplier monitoring</td>
<td>1.00</td>
<td>5.00</td>
<td>3.15</td>
<td>.94</td>
</tr>
<tr>
<td>GPP drivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory driver</td>
<td>1.00</td>
<td>5.00</td>
<td>4.16</td>
<td>.82</td>
</tr>
<tr>
<td>Rewards and incentive driver</td>
<td>1.33</td>
<td>5.00</td>
<td>4.00</td>
<td>.78</td>
</tr>
<tr>
<td>Non-governmental stakeholder</td>
<td>1.00</td>
<td>5.00</td>
<td>3.81</td>
<td>.85</td>
</tr>
<tr>
<td>GPP-related knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of regulations</td>
<td>1.00</td>
<td>5.00</td>
<td>2.89</td>
<td>.86</td>
</tr>
<tr>
<td>Knowledge of responsibilities</td>
<td>1.00</td>
<td>5.00</td>
<td>2.49</td>
<td>.97</td>
</tr>
<tr>
<td>Knowledge of experiences in developed countries</td>
<td>1.00</td>
<td>5.00</td>
<td>2.24</td>
<td>.90</td>
</tr>
</tbody>
</table>

### Table 5

Moderation effects for knowledge of regulations on relationships between green public procurement drivers and practices.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Green products and service preference</th>
<th>Green logistics</th>
<th>Green supplier monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory drivers (RD)</td>
<td>Step 1: .245***</td>
<td>Step 2: .280***</td>
<td>Step 3: .428***</td>
</tr>
<tr>
<td></td>
<td>Step 1: .235***</td>
<td>Step 2: .263**</td>
<td>Step 3: .367***</td>
</tr>
<tr>
<td></td>
<td>Step 1: .270**</td>
<td>Step 2: .307***</td>
<td>Step 3: .413***</td>
</tr>
<tr>
<td>Rewards and incentive drivers (RID)</td>
<td>Step 1: .040</td>
<td>Step 2: -.001</td>
<td>Step 3: -.099</td>
</tr>
<tr>
<td></td>
<td>Step 1: .009</td>
<td>Step 2: .023</td>
<td>Step 3: -.078</td>
</tr>
<tr>
<td></td>
<td>Step 1: -.089</td>
<td>Step 2: -.128</td>
<td>Step 3: -.203*</td>
</tr>
<tr>
<td>Non-governmental stakeholder drivers (NSD)</td>
<td>Step 1: .112</td>
<td>Step 2: .099</td>
<td>Step 3: .092</td>
</tr>
<tr>
<td></td>
<td>Step 1: .233*</td>
<td>Step 2: .225**</td>
<td>Step 3: .215*</td>
</tr>
<tr>
<td></td>
<td>Step 1: .242*</td>
<td>Step 2: .233**</td>
<td>Step 3: .238**</td>
</tr>
<tr>
<td>Knowledge of regulations (KREG)</td>
<td>Step 1: .486***</td>
<td>Step 2: .491**</td>
<td>Step 3: .329**</td>
</tr>
<tr>
<td></td>
<td>Step 1: .232*</td>
<td>Step 2: .225**</td>
<td>Step 3: .308**</td>
</tr>
<tr>
<td></td>
<td>Step 1: .308**</td>
<td>Step 2: .412</td>
<td>Step 3: .266**</td>
</tr>
<tr>
<td></td>
<td>Step 1: -.199</td>
<td>Step 2: -.199</td>
<td>Step 3: .365**</td>
</tr>
<tr>
<td>RD*KREG</td>
<td>Step 1: -.218*</td>
<td>Step 2: -.218*</td>
<td>Step 3: -.218*</td>
</tr>
<tr>
<td></td>
<td>Step 1: .170</td>
<td>Step 2: .170</td>
<td>Step 3: .170</td>
</tr>
<tr>
<td></td>
<td>Step 1: .259*</td>
<td>Step 2: .259**</td>
<td>Step 3: .167</td>
</tr>
<tr>
<td>NSD*KREG</td>
<td>Step 1: -.185</td>
<td>Step 2: -.185</td>
<td>Step 3: -.185</td>
</tr>
<tr>
<td></td>
<td>Step 1: -.142</td>
<td>Step 2: -.142</td>
<td>Step 3: -.199</td>
</tr>
<tr>
<td></td>
<td>Step 1: .170</td>
<td>Step 2: .170</td>
<td>Step 3: .170</td>
</tr>
<tr>
<td></td>
<td>Step 1: .167</td>
<td>Step 2: .167</td>
<td>Step 3: .167</td>
</tr>
<tr>
<td>F for the step</td>
<td>Step 1: 8.43***</td>
<td>Step 2: 63.81***</td>
<td>Step 3: 7.93***</td>
</tr>
<tr>
<td></td>
<td>Step 1: 13.31***</td>
<td>Step 2: 27.00***</td>
<td>Step 3: 4.67***</td>
</tr>
<tr>
<td></td>
<td>Step 1: 11.56***</td>
<td>Step 2: 33.43***</td>
<td>Step 3: 3.72*</td>
</tr>
<tr>
<td>F for the regression</td>
<td>Step 1: 8.43***</td>
<td>Step 2: 24.56***</td>
<td>Step 3: 19.10***</td>
</tr>
<tr>
<td></td>
<td>Step 1: 13.31***</td>
<td>Step 2: 18.19***</td>
<td>Step 3: 13.03***</td>
</tr>
<tr>
<td></td>
<td>Step 1: 11.56***</td>
<td>Step 2: 18.60***</td>
<td>Step 3: 12.71***</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>Step 1: .111</td>
<td>Step 2: .346</td>
<td>Step 3: .416</td>
</tr>
<tr>
<td></td>
<td>Step 1: .169</td>
<td>Step 2: .274</td>
<td>Step 3: .316</td>
</tr>
<tr>
<td></td>
<td>Step 1: .140</td>
<td>Step 2: .280</td>
<td>Step 3: .312</td>
</tr>
</tbody>
</table>
environmental concerns into their supplier monitoring for green procurement practices. The competition for these financial and reward incentives may be causing a perverse practice of not benchmarking and less careful monitoring so that greater incentives based on anecdotal information or perceived information is utilized. That is, if there are greater rewards and incentives in place for GPP, then officials may be less likely to monitor so that the best can be assumed. If these officials monitor their suppliers closely they might find greater discrepancies in performance (things that went wrong) and be less likely to receive awards. This unexpected relationship is an issue worthy of additional investigation.

For the non-governmental stakeholder drivers factor, the results are shown in Tables 5–7. No significant betas for relationships with GP exist. Hypothesis 1c is not supported for this specific GPP practice and its relationship to non-governmental drivers. However, the GL and GS practices factors are positively and significantly related to the non-governmental stakeholder pressure for all three steps in Tables 5 and 6 as well as Step 1 in Table 7. This result generally supports Hypothesis 1c for these two GPP practices. These results indicate that non-governmental stakeholder drivers are not associated with GP practices and are associated with GL and GS practices. These situations may result from the fact that the GP practices are not regularly encountered or influenced by non-governmental stakeholders. There may be greater awareness of both GL and GS practices by non-governmental stakeholders, with greater opportunities for involvement in these practices and the information sharing activities that are more evident. For example, there are greater benefits associated with benchmarking and requirements for ISO 14001 certification. Organizations can provide greater benefits and having these additional improvement efforts may influence how GPP is perceived if organizations make true changes.

4.3.2. Discussions on moderation effects by knowledge of regulations

Table 5 shows the moderation effect of the knowledge of regulations factor on the relationship between GPP drivers and practices. All three F statistics change values (F-value for the step) for the third steps are significant, and thus moderation effects of regulatory knowledge exist for GPP drivers and all three types of GPP practices. H2a is supported.

A closer examination shows six significant betas for Step 3. Three significantly positive betas are related to rewards and incentives drivers. Given greater knowledge of regulations, rewards and incentives drivers tend to have a greater, more influential relationship with adoption of GPP practices. Thus, if government is to use rewards and incentives, which may be part of the policy itself, greater knowledge and awareness, e.g. through publicity campaigns can greatly increase the effectiveness of these rewards and incentives mechanisms (Xie, 2009), affecting adoption of all three types of GPP practices.

Unexpectedly two significantly negative betas exist for the interaction terms related to both regulatory and non-governmental stakeholder drivers with GP. These results indicate that government officials who experience GPP-related regulatory and stakeholder pressures are more reluctant to implement GP practices if they have greater knowledge of GPP regulations. Interestingly,

Table 7

Moderation effects for knowledge of experienced in developed countries on relationships between green public procurement drivers and practices.

<table>
<thead>
<tr>
<th>Dependent factors (Green public procurement practices)</th>
<th>Green products and service preference</th>
<th>Green logistics</th>
<th>Green supplier monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory drivers (RD)</td>
<td>Step 1</td>
<td>Step2</td>
<td>Step3</td>
</tr>
<tr>
<td>Rewards and incentive drivers (RID)</td>
<td>.246*</td>
<td>.327***</td>
<td>.380***</td>
</tr>
<tr>
<td>Non-governmental stakeholder drivers (NSD)</td>
<td>.045</td>
<td>.012</td>
<td>-.006</td>
</tr>
<tr>
<td>Knowledge of experiences in developed countries (KEDC)</td>
<td>.113</td>
<td>.051</td>
<td>.035</td>
</tr>
<tr>
<td>RD*KEDC</td>
<td>.302***</td>
<td>.270***</td>
<td>.349***</td>
</tr>
<tr>
<td>RID*KEDC</td>
<td>.026</td>
<td>.243**</td>
<td>.177</td>
</tr>
<tr>
<td>NSD*KEDC</td>
<td>-.098</td>
<td>-.117</td>
<td>-.047</td>
</tr>
<tr>
<td>F for the step</td>
<td>8.90***</td>
<td>19.49***</td>
<td>3.17</td>
</tr>
<tr>
<td>F for the regression</td>
<td>8.90***</td>
<td>12.24***</td>
<td>8.61***</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.116</td>
<td>.200</td>
<td>.228</td>
</tr>
</tbody>
</table>
these results could come from the voluntary nature of GPP regulations in China. We note that most of the GPP-related regulations such as the "Circular Economy Promotion Law" are voluntary rather than mandatory (Geng et al., 2012; Zhu et al., 2011b), and also have loopholes (Geng and Doberstein, 2008). Thus, after officials gain knowledge of details concerning these regulations, they realize that there may be limited, if any, punishment for non-green procurement practices. Thus, ignorance of the law may actually be beneficial to GPP practices implementation. An alternative explanation for these negative moderation results is that many of the practices in GPP are not explicitly outlined in the regulations (even the voluntary ones). If these practices are not directly stated, and the officials realize it, they will give less attention to the practices. These are our current interpretations, careful and additional examination is required. Whether these environment and regulatory explanations are valid is an important future research direction for this unexpected moderation relationship. Additional interviews with officials on these issues can be further pursued in more detailed case studies.

Another significantly negative beta exists for the relationship between regulatory drivers and GS practices. Compared to other two GPP practices, GS is typically a more intensive effort by the officials. Government officials require greater knowledge and have monitoring systems in place. Checking and monitoring suppliers' environmental records or completing formal environmental evaluations requires this additional effort. With limited non-governmental stakeholder pressure and little special knowledge on environmental issues, officials will not seriously integrate environmental issues into their supplier selection after they realize that most GPP related regulations are voluntary and no clear and serious punishments exist.

4.3.3. Discussions on moderation effects about knowledge of responsibilities

Table 6 shows moderation effects of responsibilities. All three F value changes for Step 3 are not significant. Thus, Hypothesis 2b is generally not supported. Further evaluation does identify two weakly significant beta values. One beta value is positive for the moderation effect for knowledge of responsibilities on the relationship between rewards & incentive drivers and GP practices. The other beta value is a negative moderation effect for the relationship between regulatory drivers and GS practices.

Utilizing the moderation results from the significant interaction terms' beta values we can make two tentative observations. To promote GP practices effectively and achieve sustainable development, governments should consider broader incentives and make them explicit part of the responsibilities of the officials (and make these officials aware of those responsibilities). Thus, with more knowledge on their responsibilities to diffuse environmental concerns to producers and individual consumers (Brammer and Walker, 2011; Walker and Preuss, 2008), government officials would more proactively implement GP practices.

Although surprising still, with more knowledge of responsibilities regulatory drivers cause lessened GS practices adoption. Similar to the previous negative relationship analysis, it may be that the regulations do not explicitly spell out the responsibilities that government officials and agencies do not monitor suppliers closely. As a result, governments' efforts on green supplier monitoring may be reduced.

4.3.4. Discussions on moderation effects about knowledge of experiences in developed countries

Table 7 shows the moderation effects of officials' knowledge about developed countries' practices. Only one F for Step 3 for the GP practice is significant, which partly supports Hypothesis 2c. A further check shows that two positively significant betas exist, and both relate to rewards and incentive drivers for GP and GL practices.

Providing greater knowledge by building officials' experiences in developed countries, governments can further support GP and GL practices adoption. For example helping to achieve environmental goals such as for the Kyoto targets and diffusing innovative environmental technologies knowledge can greatly enhance the consciousness of government officials (van Asselt et al., 2006). Developed countries balance economic cost and environmental performance for their GPP programs. With more knowledge about GPP goals in developed countries, Chinese government officials who consider environmental impacts beyond their procurement costs and understand the rewards and incentive systems, may be more likely to actively implement GP and GL practices.

5. Conclusions and future research

5.1. Conclusions

As the largest developing country, China has made significant effort through regulatory policies to promote GPP practices (Geng and Doberstein, 2008). GPP efforts can also cause performance improvements (McCrudden, 2004). We arrived at a number of observations and conclusions that can help drive policy and improve adoption of GPP practices. Similar to developed countries, costs due to limited budgets are still key barriers, and thus financial support and economic incentives for GPP practices is currently required. Non-governmental stakeholders in China have limited but increasing influence on GPP practices. Regulatory, reward and incentive systems, and stakeholder pressures are each related to Chinese officials' implementation of GPP practices.

The first issue for GPP practices in China is related to regulations' ambiguity and lack of knowledge of knowledge of these regulations by government officials and employees. According to experiences in developed countries, both regulatory policy (Arrowsmith, 2004; Trepte, 2007) and clear GPP guidelines (Arrowsmith, 2008) are needed to promote GPP practices. Interestingly, with more knowledge of detailed regulations, Chinese government officials tend to be more reluctant to implement green products and service preference practices. These outcomes may result from the situation that most GPP related laws in China are promotion-oriented (incentives and bonus based) rather than mandatory, and most regulations are voluntary (Zhu et al., 2011b). In addition, there might be ambiguity in the actual regulatory policies on what is viewed as acceptable practices and who might be responsible for these practices. Thus, it is crucial for China to develop and enact clearer and stricter regulations which should clarify responsibilities for different stakeholders. Moreover, related penalties for different situations could be viewed as necessary making these regulatory policies more mandatory and less voluntary. The incentives and reward systems in place right now may actually have a negative relationship in the pressures and adoption of some specific practices such as supplier monitoring. These unintended consequences need to be carefully evaluated and future research, case studies with detailed interviews may be necessary to understand the nuances of the reasons for some contradictory results are occurring.

Chinese officials may still have vague and ambiguous perspectives on their responsibilities. Even in developed countries, officials usually hesitate to take risk to implement GPP practices (Carlsson and Waara, 2006). GPP practices not only require suppliers to be green, there is also an aim to motivate environmental practices among private sectors and individual consumers (Ho et al., 2010). Learning experiences in developed countries (Kunzlik, 2003), Chinese governments can provide financial support such as subsidies
and tax relief to encourage companies to produce greener products through technology innovations and eco-design. Only with effort by all stakeholders including governments, companies and individual consumers, can GPP practices achieve the goal of sustainable development.

Developed countries have initiated GPP practices earlier than China, and thus have more mature regulations and promotion systems. China can initiate its own effective and efficient GPP related programs by learning from experiences in developed countries. One key aspect for such learning is to consider the whole life cycle cost of one product. Establishing appropriate regulations, ensuring effective implementation, and providing necessary information such as lists of green products and green manufacturers, are also important to help in greater adoption of these practices in China.

5.2. Research limitations and future research

Using the developed conceptual model, we examine the relationships among GPP motivators (pressure/drivers), related knowledge and practices. We identified weaknesses of GPP practices in China and examined moderation effects of related knowledge on the relationship between GPP pressure/drivers and practices. But, research limitations and our results raise additional questions that provide fodder for future research. Thus a number of worthwhile future research directions exist.

Our research limitations include from where and whom we gathered information. Expanding this study to other regions of China and even developed countries will be necessary. Also, may be including another perspective (as recommended by a previous study (Murray, 2009)) to explicitly include politicians who developed these regulations to determine motivation, would be a complementary study worth pursuing. With empirical surveys, even with attempts to minimize respondent bias, there might still be issues of social desirability concerns. Triangulation studies that include detailed cases, observational field studies, and archival data analysis may be ways to further enhance this study and minimize some of the common method biases associated with survey research.

But as noted, research limitations provide avenues for future research. In addition, we have identified other directions for future research. Another future research direction may be performance evaluation for GPP practices. Governments aim to reduce environmental impacts of the whole life cycle of one product by GPP practices but at the same time need to consider cost or procurement budgets. Simultaneously governments also want to develop benchmarks of their GPP practices and diffusse their efforts to private sectors and individual consumers. Lack of evaluation indicators is a key barrier for GPP practices in China (Geng and Doberstein, 2008). However, what performance indicators should be adopted for GPP practices is a challenge not only for developing countries, but also for developed countries with a relatively long history of GPP practices.

Our results show some conflicting and surprising results. For example, there are a number of unexpected results that show less adoption when there is greater knowledge of regulations and responsibilities. This increase in knowledge of regulations having a negative effect on the relationships between drivers and practices, is a dilemma that needs to be addressed. The cause of this negative relationship, whether it is lack of clarity or whether it is the voluntary nature of the regulations (or other reasons) needs further evaluation and consideration. Whether these results are true for other regions of China clearly needs further investigation and addresses our limitation of only focusing on the Shenyang region of China.

Another future research direction can be investigation of diffusion systems for GPP practices. Currently, Chinese government officials and employees know little about GPP-related regulations and policies in developed countries. Learning from developed countries while considering the situation in developing countries such as China requires greater investigation. More broadly, how to expand successful green procurement networks from developed countries to other regions of the world requires additional study. This global diffusion will require consideration of various cultural, social, and institutional barriers. These considerations will require substantive research. Domestically, in China, further research on how to develop diffusion systems to promote GPP practices from leading government departments to lagging ones (internal benchmarking and best practices efforts) as well as to other stakeholders such as private companies and individual consumers is needed. This initial study provides a number of interesting future research directions. The results can prove useful for both developed and developing countries. If developing countries will be the driver for future sustainability efforts worldwide, understanding the roles and effectiveness of government and government purchasing in sustainability and greening efforts is an important and necessary step. This study helps us to move in that direction of further understanding.

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