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Analyzing local content and in-country spending requirements to advance technology transfers and support entrepreneurial development in Ghana's upstream petroleum sector

Frank Yao Gbadago[1]✉

This study investigates the role of local content requirements (LCRs) and in-country spending mandates in fostering technology transfer, skills acquisition, and entrepreneurship development in Ghana's upstream petroleum sector. Leveraging theories such as Grossman's domestic content preference, resource dependency, linkage and spill-over effects, and social exchange, the research provides a comprehensive perspective on how local content policies can generate sustainable socio-economic benefits, extending beyond immediate fiscal gains. Through robust quantitative analysis, including factor analysis with high Cronbach's alpha values (0.700 to 0.932) and composite reliability near 1, the study confirms the significant role of LCRs in driving collaborative engagements between foreign operators and local businesses. The findings underscore the efficacy of LCRs policies and partnerships in enhancing local business capacities, particularly through technology and knowledge transfers. However, the research also highlights gaps in policy enforcement and local capacity development, revealing limited impact of in-country production spending on entrepreneurial growth. This study makes a novel contribution by integrating multiple theoretical perspectives into a unified framework that explains the dynamics of LCRs impacts in the context of an emerging economy. The implications for policymakers include enhancing regulatory enforcement, fostering capacity-building programs, and incentivizing partnerships between foreign and local firms to boost local industry competitiveness. This study's contributions to the field lie in providing a rigorous framework for assessing LCRs efficacy and offering actionable insights for maximizing the socio-economic impact of resource policies in petroleum-rich economies like Ghana. Future research directions include examining similar dynamics in other resource-driven sectors and exploring the long-term socio-economic impacts of LCRs, including job creation and poverty alleviation.

[1] Department of Accounting Studies, Faculty of Business Education, Akenten Appiah-Menka University for Skills Training & Entrepreneurial Development, Kumasi, Ghana. ✉email: frankggh@yahoo.com

Introduction

The ambition of promoting employment and enhanced local participation in the ownership and production of petroleum resources and related value-chain activities, shapes policy instruments of host governments (Kazzazi & Nouri, 2012; Sigam & Garcia, 2012; Acheampong, Ashong & Svanikier, 2016). As a result, many host-endowed nations implement local content and in-country spending requirements, now globally recognised as essential tools for maximising resources in the upstream petroleum sector. According to Asiago (2017), these requirements are designed not only to secure fiscal revenue but also to foster broader economic benefits that endure beyond the petroleum resource lifecycle. Specifically, these policies impose performance mandates on upstream operators, mainly foreign multinational firms, requiring them to utilize local labour and materials and facilitate technology transfers to local firms. This approach supports local entrepreneurship development and ensures that the created values and gains are retained within the host economy (Adjei & Ackah, 2023; Kragelund, 2017; Lebdioui, 2019).

In many endowed economies, a lack of technology, skills, knowledge, and more importantly, capital limits the ability to independently explore, develop and produce petroleum resources. Consequently, these nations often partner with foreign multinational firms, thus, relying on local content policy requirements to facilitate the transfer of technology, skills and knowledge to local firms and entrepreneurs. These measures align with the United Nations' Sustainable Development Goals (SDGs). However, limited evidence exists, both in practice and in the literature that provides a clear picture of how these technology, skills and knowledge needs are being addressed through existing policy requirements. This gap invites further enquiry to understand and provide evidence of how effectively local content requirements, including in-country spending mandates, fulfil these objectives.

In order to address the identified gap and guide future research, this paper poses two critical research questions. First, to what extent do local content requirements promote technology transfer to local businesses within petroleum-endowed economies, particularly in emerging economies like Ghana? Second, how do in-country spending mandates influence entrepreneurship development in the upstream petroleum sector, both broadly and within the specific context of Ghana? These questions aim to clarify and document the effectiveness of local content requirements and in-country spending mandates in fostering the sustainable transfer of technology, skills, and knowledge to support industrial growth and entrepreneurship development, as well as related opportunities in host countries.

Previous studies suggest that local content requirements prioritize in-country input factor sourcing and related spending in-country, which aims at inspiring local value creation and retention, linkages, knowledge and technology transfer, local firm engagement and participation, job creation and entrepreneurship opportunities within petroleum-endowed economies (Ablo, 2015; Acheampong et al., 2016; Adedeji et al., 2016; Adjei & Ackah, 2023; Kazzazi & Nouri, 2012; Tordo et al., 2013). Acs, Audretsch and Lehmann (2013) found that in-country sourcing, spending and collaborative engagements between upstream petroleum operators and local firms support technology and skills transfers, providing pathways for entrepreneurship development, and economization. Similarly, Hunter (2014) and Macatangay (2016) note that such activities, along with inspired linkages and entrepreneurial opportunities, guarantee optimal and sustainable socio-economic benefits that extend beyond government meantake, even long after the resource is depleted. However, a critical question remains: how are these objectives being achieved, and to what extent are they effective?

The argument for local content and in-country spending requirements is based on fostering technology, knowledge, and skills transfers to local businesses. These policies also encourage entrepreneurship development and socio-economic benefits that extend beyond government revenue. Grossman's (1981) domestic content preference and protection theory, along with resource dependency, linkage, spill-over effect, and social exchange theories, provide the theoretical foundation for these ideas (Adewuyi & Oyejide, 2012; Kazzazi & Nouri, 2012; Adedeji et al., 2016; Asiago, 2017). For instance, Kazzazi and Nouri (2012), drawing from Grossman's domestic content preference and protection theory, advocated for local content and in-country spending requirements in the upstream petroleum sector.

However, resource dependency theory views these requirements as restrictions, suggesting the need for collaborative strategies and related business practices to manage resource dependency effectively (Gbadago et al., 2023; Ngoasong, 2014). Zehir et al. (2019) underscored the responsive collaborative engagement practices as critical for managing the underlying resource dependency together with the imposed requirements as performance mandates. Linkage and spill-over effects theory on the other hand underscores collaborative engagement practices as crucial for stimulating cross-sectorial linkages and spill-over effects such as technology, knowledge, and skills transfers and entrepreneurship opportunities (Ihua, 2010; Acs et al., 2013; Lebdioui, 2019).

Domestic content preference and protection, combined with collaborative engagement in resource dependency, foster linkages and spill-over effects. These linkages create socio-economic benefits for both parties in resource dependency relationships and the wider society. This is the primary aim of local content and in-country spending requirements legislation. These principles align with social exchange theory, which emphasizes the need for rules, accepted norms, and cultural practices that define obligations and benefits within resource dependency relationships. This framework ensures mutual benefits for all involved, including the broader society (Bloch & Owusu, 2012; Drees & Heugens, 2013; Redmond, 2015; Asiago, 2017; Gbadago et al., 2023).

Given these assumptions and the need to promote socio-economic benefits from petroleum resources and related value-chain activities, many petroleum-endowed economies, such as Norway, Botswana, Nigeria, and Ghana, have widely adopted local content and in-country spending requirements as effective resource use policies (Tordo et al., 2013; Ablo, 2015; Suleman & Zaato, 2021; Gbadago et al., 2023). Despite the importance of these measures, a key question remains. To what extent do these mandates genuinely promote the transfer of technology to local businesses and contribute to entrepreneurship development in resource-rich economies?

For instance, Suleman and Zaato (2021), reported that technology, knowledge and skills transfers to local firms and entrepreneurs in Ghana's upstream petroleum sector are significantly limited. Their observation highlights unwillingness and reluctance of most petroleum operators to transfer technology, knowledge and skills to local businesses and entrepreneurs, including the Ghana National Petroleum Corporation (GNPC). Moreover, there is an observed resistance from many multinational oil companies towards complying with the 10% equity participation mandates outlined in the Ghanaian local content and local participation regulations, 2013 (L.I. 2204) (see Suleman and Zaato, 2021).

The observed hurdle affects the transfer of technology, knowledge, and skills to local businesses, hindering entrepreneurship development. Suleman and Zaato (2021) noted that this

limitation impacts local firms' ability to secure a significant share of in-country sourcing and spending within the upstream petroleum sector, primarily due to a lack of technical know-how. Moreover, the degree to which the minimal transferred technology, knowledge, and skills enhance the competitiveness and capacity of local firms remains unclear. This uncertainty stems from limited and inconclusive research efforts in this area (Tordo et al., 2013; Ablo, 2015; Lebdioui, 2019). Acheampong et al. (2016) and Macatangay (2016) attributed this scarcity of research to challenges in research design, data collection, and difficulties in operationalizing and measuring variables related to local content requirements. These issues explain why the few studies in this domain tend to be qualitative.

In light of the foregoing discussions, this study addresses the identified research gap, by examining how local content requirements, in-country production spending, and value retention mandates in the upstream petroleum sector impact the transfer of technology, knowledge, and skills to local businesses. Additionally, it explores how these policy requirements influence entrepreneurship development, particularly in resource-endowed economies like Ghana. To answer the research questions, and enhance understanding, this paper developed a conceptual model based on lessons learned from existing literature. The methodology also addresses challenges related to data collection, variable operationalization, and measurement by developing an instrument for assessing local content requirements, in-country spending, collaborative engagements, government policy effectiveness, and the transfer of technology, knowledge, and skills to local businesses and to support entrepreneurship development. The model, along with the instrument, and underlying variables were further validated using data from a developing economy context.

The critical contributions of this paper lie in its systematic approach to measuring the relationship between local content policy requirements, in-country spending, technology transfers, and entrepreneurship development. Furthermore, the paper introduces a conceptual framework integrating domestic content protection, resource dependency, linkage and spill-over effect, and social exchange theories, expanding our understanding of these concepts in the context of local content policy requirements and economic development. The subsequent sections include a review of relevant literature, development of the conceptual framework, research methodology, and presentation of results and discussion. The paper concludes with an exploration of the implications of the findings, contributions, limitations of the study, and areas for further research.

Review of literature

The existing literature on resource dependency, collaborative engagements, linkages, and spill-over opportunities highlights the role of technology spill-overs and entrepreneurship in driving socio-economic development in petroleum-rich economies (Ablo, Overå (2015); Acs et al., 2013; Esteves & Barclay, 2011). In Ghana, studies emphasize the critical importance of local content policies in enabling these outcomes. For instance, Ablo (2015) stress the significance of institutional frameworks and capacity development in ensuring effective implementation of local content policies. Similarly, Ablo (2018; 2019) underscores the challenges local businesses face in benefiting from technology transfers and entrepreneurship opportunities due to capacity constraints and limited access to finance.

This body of work underscores the critical need for a deeper understanding of the impact of local content and in-country spending requirements on technology, knowledge, and skills transfers, particularly in the Ghanaian context. Additionally, the responsive collaborative engagement practices of upstream petroleum sector operators, as highlighted by Suleman and Zaato (2021), play a crucial role in promoting entrepreneurship development. Therefore, understanding the dynamics of these relationships is essential for ensuring that local content policies effectively contribute to socio-economic development in resource-endowed economies like Ghana.

Ngoasong (2014) reported that local content and in-country spending requirements significantly influence the collaborative engagement strategies adopted by upstream petroleum operators across petroleum-endowed economies. These strategies are seen as vital for managing both the threats and opportunities presented by performance mandates. According to Asiago (2016) and Ngoasong (2014), such engagements aim to secure a social license to operate, ensure compliance, support local input sourcing, or fulfil corporate social responsibility by developing local communities. This understanding is crucial for refining and improving petroleum resource use policies and enhancing value-chain activities in resource-endowed economies like Ghana.

Researchers such as Acs et al. (2013), Hanlin & Hanlin (2012), and Ihua, Olabowale, Eloji, and Ajayi (2011) have advocated for leveraging technology, knowledge, skills, and entrepreneurial spillover opportunities to support resource-based industrialization. In Ghana, Ablo (2015) emphasize the importance of institutional frameworks and capacity development in ensuring the successful implementation of local content policies. These studies are complemented by Suleman and Zaato (2021), who note the role of local content policies in facilitating entrepreneurship and enhancing local firms' participation in the oil and gas sector. The work of Ablo (2018; 2019) further highlights the challenges local businesses face in benefiting from these policies, particularly regarding access to finance and limited technical skills.

Sigam and Garcia (2012), Hunter (2014), Lebdioui (2019), and Gbadago et al. (2023) emphasize that local content requirements, including in-country spending mandates, are essential for promoting sustainable local participation and engaging local resources, even after resource depletion. These outcomes are closely aligned with the Sustainable Development Goals (SDGs), as they support the broader goals of inclusive economic growth and development.

Importantly, the literature on local content policies emphasizes technology, knowledge, and skills transfers, alongside entrepreneurial spillovers, as critical mechanisms for ensuring the socio-economic benefits of resource wealth are distributed to the general population (Ihua et al., 2011; Hansen, 2014; Adedeji et al., 2016). Pandford (2017) adds that the effectiveness of local content policies in Ghana's petroleum sector is often undermined by weak enforcement and limited capacity development initiatives. Similarly, Ablo (2019) argue that capacity development efforts are crucial to ensuring that local firms can meet the technological demands of the oil and gas industry.

Lebdioui (2019) and Gbadago et al. (2023) further argue that local content requirements, underpinned by in-country spending and capacity-building mandates, serve as an effective policy tool for addressing minimal local participation in upstream petroleum operations. They also highlight the role of these policies in fostering technology transfer and entrepreneurship development, which are vital for sustainable economic growth in resource-rich economies like Ghana.

Despite this understanding and the emphasis placed on local content requirements by host governments, studies by Javorcik (2004), Hansen (2014), Adedeji et al. (2016), Zoogah (2017), Kalyuzhnova and Belitski (2019), Lebdioui (2019), and Suleman and Zaato (2021) indicate ongoing scepticism regarding the ability of these policies to inspire meaningful technology transfer and entrepreneurship development. This scepticism has led to

several critical research questions that remain unresolved among researchers, industry operators, and policymakers. Thus, how does technology transfer occur within the framework of local content requirements in an upstream petroleum sector of a host economy? Another pertinent question examines how the operationalization of research variables translates into tangible technology transfers and entrepreneurship development.

Theoretically, legislating local content and in-country spending requirements in resource operations stimulates linkages and spill-over opportunities that foster technology, knowledge, and skills transfers to local businesses, promoting entrepreneurship (Acs et al., 2013). According to Gbadago et al. (2023), these ideas are grounded in Grossman's (1981) domestic content protection and content preference, Pfeffer and Salancik's (1978) resource dependency, Hirschmann's (1958) linkage and spill-over effects, and Emerson's (1976) social exchange theories, and align with the UN's Sustainable Development Goals.

Grossman's (1981) theory on domestic content protection and preference emphasizes the strategic use and enhancement of local input factors by foreign international oil operators engaged in upstream petroleum activities. This approach is vital for developing local industries and ensuring domestic business participation in the petroleum sector's value chain. Supporting this, Kazzazi and Nouri (2012) and Asiago (2016) underscore the importance of legislation that mandates local content requirements and in-country spending as critical mechanisms to regulate and guide foreign operators' engagement in local economies.

In the Ghanaian context, Amoako-Tuffour, Aubynn, and Atta-Quayson (2015) observed that enforcing Ghana's Petroleum (Local Content and Local Participation) Regulations, 2013 (L.I. 2204), has become crucial in enhancing local participation in the oil and gas sector. In addition, Ablo (2015) underscores the importance of local content policies in driving technology transfer and entrepreneurship development. However, challenges like limited technical capacity and weak institutional support hinder these opportunities (Suleman & Zaato, 2021). To this end, Asiago (2016) and Suleman and Zaato (2021) suggest that government initiatives are necessary to fully leverage local content regulations, fostering technology transfer, knowledge dissemination, and skill development from foreign operators to local businesses. They advocate for a comprehensive local content master plan to facilitate entrepreneurship, ensure sustainability, and promote the transfer of knowledge and skills.

As a theoretical lens, Linkage and spill-over theory highlight the potential connections and broader spill-over effects that resource operations and value-chain activities can have on the entire economy (Acheampong, et al., 2016; Adewuyi & Oyejide, 2012; Hunter, 2014). Hirschman (1970) referred to these linkages as 'one thing leads to another,' which Acs et al. (2013) argue should be tapped into for entrepreneurship growth. According to the theory, increased economic activity in resource use generates positive spill-over effects, driving industrialization and creating business opportunities throughout the economy as income rises and externalities emerge (Bloch & Owusu, 2012).

In Ghana, Amoako-Tuffour, Aubynn, and Atta-Quayson (2015) and Gbadago et al. (2024) emphasize that local content and in-country spending mandates as enshrined in the Ghana's Petroleum (Local Content and Local Participation) Regulations, 2013 (L.I. 2204), have fostered local linkages and spill-over effects and operator-local subcontractor engagements. These collaborative engagements include the transfer of technology and skills from foreign operators to local businesses. Additionally, Ablo (2019) and Pandford (2017) argue that the development of robust policies has boosted local entrepreneurship, further promoting industrial growth within the petroleum sector.

In support, Arhin (2023) and Panford (2017) emphasize the need for stronger capacity-building programs to enhance these benefits, while Ablo (2019) and Panford (2017) highlight the opportunities opened for Ghanaian businesses. On the other hand, Heim, Kalyuzhnova and Ghobadian (2023) showed that local content mandates create essential linkages between international and local firms, facilitating the transfer of valuable skills. Lebdioui (2019) and Gbadago et al. (2023) argue that the success of these policies depends on local firms' ability to leverage the knowledge and technology from foreign operators. When implemented effectively, local content policies can promote sustainable economic growth and ensure broader socio-economic benefits. However, success relies on robust institutional frameworks and effective collaboration between local and foreign businesses.

Similar results have been observed in other countries. Hunter (2014) reported that local content regulations in Norway encouraged technology transfers and spurred entrepreneurship development, contributing to petroleum-based industrialization. Likewise, Ihua et al. (2011) and Adedeji et al. (2016) noted that implementing local content requirements in Nigeria led to job creation and the growth of entrepreneurial ventures. The same can be expected in Ghana if local content initiatives are consistently enforced and supported with a comprehensive master plan.

The social exchange theory emphasizes that performance mandates, such as local content and in-country spending requirements, act as a form of social license to operate. These mandates create responsibilities and potential rewards for all involved parties, fostering an exchange of mutual benefits (Redmond, 2015). In this context, foreign operators comply with local content regulations to maintain legitimacy and access essential local resources, such as labour and markets. Compliance with these obligations allows operators not only to meet regulatory demands but also to strengthen their relationships with local stakeholders, leading to long-term operational benefits.

In Ghana, local content regulations in the petroleum sector require foreign companies to collaborate with local businesses, encouraging technology transfer and entrepreneurship (Amoako-Tuffour, Aubynn, & Atta-Quayson, 2015). This compliance enables operators to retain their social license while promoting economic growth and development through local participation. The exchange of resources—knowledge, skills, and technology—creates a mutually beneficial environment, where local businesses gain expertise, and foreign operators secure continued access to local resources and markets.

Furthermore, resource dependency theory highlights that collaborative engagements are a strategic response to imposed obligations, where compliance with these requirements grants operators access and control over necessary resources (Ngoasong, 2014). As a result, local content regulations and in-country spending requirements foster partnerships between foreign operators and local businesses. These collaborations generate spill-over effects that promote technology transfers and entrepreneurship development (Adedeji et al., 2015).

In Ghana, Ablo (2015) demonstrated how these collaborative efforts, including the establishment of enterprise development centres, spurred by the country's local content laws, have facilitated the transfer of technology, knowledge and skills from foreign operators to local enterprises. This has contributed to the enhancement of Ghana's entrepreneurial ecosystem by building the capacity of local businesses and enabling them to participate more effectively in the petroleum sector.

The desire of entrepreneurial economy, with job creation and local value creation and retention through local participation and ownership of upstream petroleum operations and related

value-chain activities, supported by adoption of local content requirements had seen many research efforts in technology transfers and entrepreneurship development (Ihua et al., 2011; Hunter, 2014; Adedeji et al., 2015; Unam, 2015; Jahromi, 2021). The argument for imposition of local content requirements and in-country spending mandates to inspire collaborative engagements, and related linkage and spill-over opportunities such as technology, knowledge and skills transfers and entrepreneurship development found support in the extant literature.

For instance, regarding generation of engagements to support entrepreneurship development, Adedeji et al. (2015) conceptually argued that a well-developed and implemented local content requirements with its underlying in-country spending mandates have the potency to transform Nigerian's economy to an entrepreneurial economy that generates employment through technology transfers and local participation. In support of the argument, Adedeji et al. (2015) developed a conceptual framework for analysing the interrelationships and the impact thereon among local content policy requirements, local participation and job creation, and thereafter recommended empirical investigation to test and validate their arguments as postulated in the conceptual framework.

In response, Unam (2015) examined the extent to which local content requirements and operator spending activities at the firm level impact human capital sustainable business development in Nigeria using a cross-sectional survey data collected through structured questionnaire supplemented with secondary data from the annual reports of 28 firms. Unam (2015) found that local content policy-induced spending and related engagements had significant impact on the human capital development, which contributed remarkably to the management capacity of the local oil servicing firms in the petroleum sector of Nigeria. Furthermore, it was observed that the spending and related engagements in the sector created technological and managerial linkages, which flowed to the local oil servicing firms that the firms internalized to strengthen their absorptive capabilities and improve financial performance.

Amoako-Tuffour, Aubynn, and Atta-Quayson (2015), in response to the increasing emphasis on local content in Ghana's petroleum sector, examined the impact of the Petroleum (Local Content and Local Participation) Regulations, 2013, on technology transfer and entrepreneurship development. Using social exchange theory as a framework, they found that compliance with local content mandates by foreign operators facilitated significant technology transfers and skill development within local businesses. The study concluded that the collaborative efforts between operators and local enterprises fostered sustainable growth and promoted entrepreneurship in the petroleum sector, demonstrating the mutual benefits from these exchanges.

Furthermore, Medase, Ahali, and Belitski's (2023) study explores the positive effect of natural resource rents on entrepreneurial activity in sub-Saharan Africa. Their research reveals that increased resource rents contribute to higher quality and growth in business formation. Importantly, the authors find that strong institutional quality significantly enhances this relationship, suggesting that effective governance and regulatory frameworks amplify the benefits of natural resource wealth for entrepreneurship. This work implies that to fully leverage natural resources for economic development, policymakers should prioritize improving institutional frameworks, thereby fostering a more favourable environment for sustainable business growth.

Lin and Weng's (2020) study revealed that in a monopolistic competitive market, stricter local content requirements and in-country spending mandates cannot simultaneously increase both productivity and production. On the other hand, Jahromi (2021) maintained that despite the observed improved research efforts in this domain, determining metrics for measuring local content requirements and its underlying outcomes such as technology, knowledge and skills transfers and entrepreneurship is still a challenge. Consequently, Jahromi (2021) suggested integrated and congruent approaches and regulations for facilitating achievement of the desired local content outcomes.

The foregoing discussions emphasized the convergence that imposition of local content requirements, and in-country spending mandates on operators together with government policy effectiveness stimulate collaborative engagements among the operators and local businesses and individuals as well as related local linkage and spill-over opportunities that impact transfer of technology, knowledge and skills to local businesses and entrepreneurship development within resource-endowed economies. This assertion found support with Suleman and Zaato's (2021) study that analysed local content requirements and implementation in the upstream petroleum sector of Ghana towards sustainable development. Suleman and Zaato (2021) concluded that there is evidence of local content in Ghana, which supports minimal technology, knowledge and skills transfers to local businesses and entrepreneurship development. According to Suleman and Zaato's (2021) study, attributed the observed minimal technology transfers and entrepreneurship development to inadequate local capacity and linkage factors, which impact the ability of the local businesses and entrepreneurs to capture in-country spending and/or attract operator engagements. Accordingly, Suleman and Zaato call for concerted and effective policy interventions and deliberate efforts from the state and its regulatory institutions, especially the Petroleum Commission.

Furthermore, Gbadago et al. (2023) underscored the critical roles that effective government policy efforts and local content interventions play to influence the development of key local factors and supplier effectiveness. Prior to arriving at the above-stated conclusion, Gbadago et al. (2023) examined the role of the key local factors, local supplier effectiveness on local linkage effectiveness to support local requirements and in-country spending and value retention and technology transfers using data from the upstream petroleum sector of Ghana. The results of their studies showed that policy efforts and interventions stimulate relevant linkages and spill-over opportunities, which influence the ability of local content requirements and in-country spending mandates to positively impact technology transfers and entrepreneurship.

Heim et al. (2023) in response to the growing need for awareness of technology spill-over opportunities, examined the effect of state linkage and spill-over inducing policies and operating strategies of international petroleum operators on technology transfers to local businesses and entrepreneurship development in Kazakhstan among the petroleum and information communication sectors. The study concluded that introduction of such policy efforts by the state and responsive strategies by operators impact opportunities for sustainable operations on the part of multinationals in resource-abundant host countries. The results also showed that local capabilities developed from collaborative engagements impact transfer of expertise and technology to local businesses, which support access to international, and strategic opportunities with long-term benefits.

Conceptual framework and generation of suppositions

Drawing on a prevailing body of knowledge in the upstream petroleum operations and local content requirements research domain, coupled with the lessons learned from the foregoing discussions, this study proposed a conceptual framework of local content requirements, in-country spending mandates and

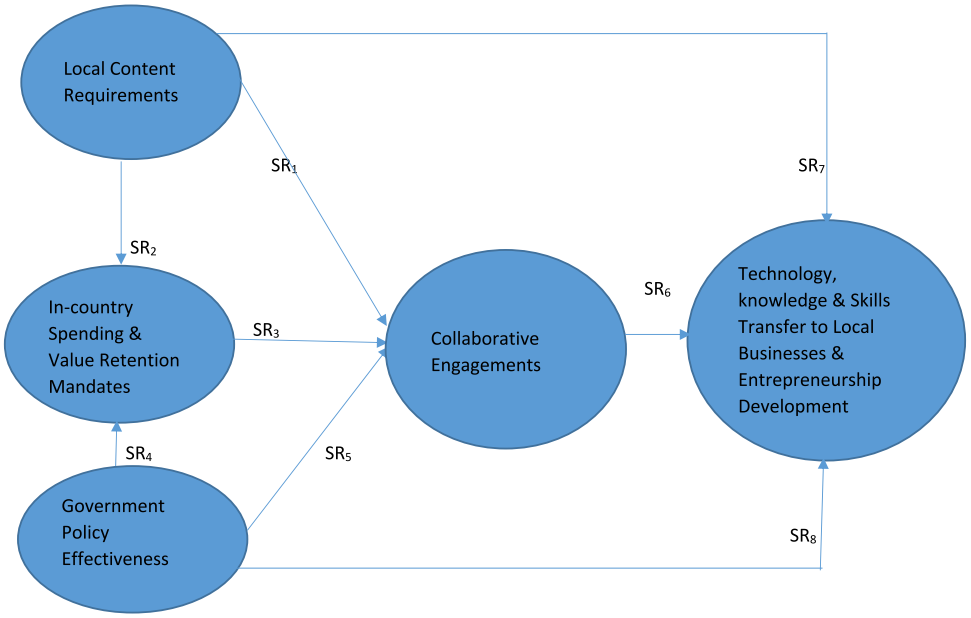

Fig. 1 Conceptual Framework of local content requirements, in-country spending mandates, collaborative engagements, technology transfers to local businesses and entrepreneurship development and Underlying Supposition. Source: Authors' Conceptualization Based on Literature.

technology, knowledge and skills transfers to local businesses and entrepreneurship development. The underlying suppositions are as shown in Fig. 1. Based on views in extant literature, we link local content requirements, and government policy effectiveness to in-country production spending mandates. In line with the underlying theories, these variables together are linked to collaborative engagement practices to influence technology, knowledge, and skills transfers to local business and entrepreneurship development.

We likewise demonstrate the direction of the relationships between these variables. Collaborative engagement practices were introduced as a contingent factor to illustrate its mediating role between the exogenous variables local content requirements, in-country spending, and government intervention and the technology transfer to local businesses and entrepreneurship development based on prior literature supported by the domestic content protection and preference, resource dependency, social exchange, linkage and spill-over effect theories as shown in Fig. 1.

The key propositions or statements of relationships (SR) emanating from the above review, and postulated in the proposed conceptual framework are as outlined below:

SR 1: Local content requirements predict collaborative engagement practices.

SR 2: There is a positive relationship between local content requirements and upstream petroleum operators' in-country spending in Ghana.

SR 3: In-country spending mandates impact collaborative engagement practices.

SR 4 Government policy effectiveness impacts In-country spending mandates.

SR 5: Government policy effectiveness affects collaborative engagement practices.

SR 6: Collaborative engagements directly impact Technology transfers and entrepreneurship development.

SR 7: Technology transfers and entrepreneurship development are significantly influenced by the implementation of local content requirements in the Ghanaian upstream petroleum sector.

SR8: Government policy effectiveness significantly contributes to technology transfer and entrepreneurship development in the Ghanaian upstream petroleum sector.

SR 9: Increased in-country spending by upstream petroleum operators positively correlates with enhanced technology transfers in Ghana.

SR10: Successful technology transfers, facilitated by local content requirements, lead to increased opportunities for local entrepreneurship development in Ghana.

Methodology

Research design and approach. The current study employed a quantitative survey research design using structured self-administered questionnaires to collect data from key personnel within upstream petroleum firms in Ghana. The choice of this design was informed by its proven effectiveness in gathering data from a geographically dispersed population within a short time and at minimal cost while maintaining respondent anonymity (Amoako-Tuffour, Aubynn, & Atta-Quayson, 2015; Robertson & McCloskey, 2002). Similar survey designs have been widely utilized in studies investigating local content policies and their impact on technology transfer and entrepreneurship in Ghana's oil and gas industry (Gbadago et al., 2023; 2024).

Given the exploratory nature of this study, which sought to assess the effectiveness of local content requirements in promoting technology transfers, knowledge sharing, skill and entrepreneurship development, the survey design was particularly suited for collecting quantifiable data on the respondents' perceptions and experiences. The structured questionnaires provided a standardized format for gathering insights from multiple firms, facilitating a detailed analysis of the variables under investigation. The study focused on upstream petroleum operators, subcontractors, service providers, and consultancy firms, all registered with the Petroleum Commission of Ghana. This approach is consistent with previous research that has effectively used survey methods to examine local content and technology transfer issues in upstream petroleum sector (Adedeji et al., 2016; Ihua et al., 2011).

The decision to use a self-administered questionnaire was further supported by the findings of Adedeji et al. (2016) and Amoako-Tuffour et al. (2015), who highlighted the practicality of this method in collecting high-quality data from executives and managers in the petroleum sector. By employing this approach,

the study was able to gather critical insights from experienced respondents directly involved in local content compliance and operations, including collaborative engagements that facilitated technology, skills, and knowledge transfers. These elements ensured both the relevance and reliability of the data collected, contributing to a deeper understanding of how local content requirements influence technology transfer and entrepreneurship development in Ghana's upstream petroleum sector.

Development of instruments and variable operationalization. The study utilized a self-administered structured questionnaire developed based on extensive literature on local content, technology transfer, and entrepreneurship within the oil and gas sector (Ablo, 2015; Adedeji et al., 2016; Amoako-Tuffour et al., 2015; Bloch & Owusu, 2012; Esteves & Barclay, 2011). The questionnaire was designed to capture key variables including compliance with local content requirements, technology transfer, skills development, entrepreneurship, collaborative engagements, government policy effectiveness, and in-country spending and value retention.

All items were measured on a five-point Likert scale (from 'strongly disagree' to 'strongly agree') to ensure a standardized method for capturing both perceptions and experiences (Sekaran & Bougie, 2016). This approach facilitated the quantitative assessment of respondents' experiences and perceptions concerning the impacts of local content policies, technology transfer, and entrepreneurship, enabling clear comparison across variables and participants.

The questionnaire consisted of five main sections reflecting the core variables of the study, as shown in Table 1. The first section explored local content requirements, focusing on the respondents' experiences with compliance, especially in integrating local suppliers and workers. The second section assessed technology transfer, skills development, and entrepreneurship development, capturing both the tangible experiences of knowledge exchange, training, and innovation and perceptions of these transfers' effectiveness. The third section on collaborative engagements examined partnerships between foreign and local businesses and the role of these collaborations in fostering technology transfer and entrepreneurship. Government policy effectiveness was covered in the fourth section, where respondents shared their experiences and views on how policies promoted local content compliance and sustainable sector growth. The final section focused on in-country spending and value retention activities, assessing the impact of local procurement, employment, and infrastructure investment on domestic value creation.

The developed items supported the study to comprehensively captured both experiences and perceptions related to local content, technology transfer, and entrepreneurship development. The use of a structured questionnaire with clearly operationalized variables ensured that all key aspects of the study were rigorously measured, allowing for reliable insights into Ghana's upstream petroleum sector.

Sampling frame and sample size. The target population for this study comprised firms actively engaged in upstream petroleum operations and related value chain activities in Ghana. These included licensed operators, subcontractors, support service providers registered with the Petroleum Commission of Ghana, and relevant government institutions offering technical support to the sector. According to Adedeji et al. (2016) and Gbadago et al. (2023), firms involved in upstream petroleum activities are well-positioned to provide insights into local content requirements, technology transfers, in-country spending, subcontractor engagements, and entrepreneurship development, key areas that this study sought to explore.

In order to ensure firm-level data analysis, senior managers and executives were targeted and approached using Google Forms to respond to an Online survey. This approach was consistent with Adedeji et al. (2016), Gbadago et al. (2023), Kazzazi & Nouri (2012) and Zehir et al. (2019), who all emphasized the importance of surveying individuals with deep involvement in strategic decisions within their firms. Accordingly, the selected respondents were primarily drawn from departments directly involved in local content compliance, such as finance, local content management, supply chain, logistics, external affairs, and engineering. These departments play critical roles in the implementation of local content policies and technology transfer initiatives, making their managers knowledgeable about how such policies impact entrepreneurship development and the broader performance of their firms.

Given the competitive nature of the upstream petroleum operations, publicly available information on the firms and their operations within this sector remains limited. This posed a challenge in defining the sample, as highlighted by Kazzazi and Nouri (2012), who noted the difficulties of obtaining comprehensive data in emerging industries. Following the recommendations of Gbadago et al. (2023) and Schuster and Holtbrügge (2014), a sampling frame was constructed, based on data obtained from Ghana National Petroleum Corporation (GNPC) and the Petroleum Commission. The sampling frame included 68 licensed upstream operators and 402 subcontractors and support service providers, yielding a total target population of 470 firms (Petroleum Commission, 2019; 2021; GNPC, 2011).

The sample size for this study was determined using Yamane's (1967) sample size determination formula, which is suitable for calculating sample sizes in large populations. The formula is as follows:

$$n = \frac{N}{1 + N(e)2}$$

Where: n = required sample size, N = population size (470 firms), e = margin of error (0.05).

$$n = \frac{470}{1 + 470(0.05)2}$$

$$n = \frac{470}{2.175}$$

$$n \approx 216.$$

The determined sample size was corroborated by values from Krejcie and Morgan's (1970) sample size table, which also suggested a sample size of approximately 212 for populations of this size. To account for potential non-responses and ensure adequate representation, the sample size was increased by 10%, in line with the recommendations of Sarantakos (2005) and Sola (2014), bringing the final sample size to 238 firms. The breakdown of the population, the sample surveyed, and the valid data sets that were ultimately used in the analysis are as reported in Table 2.

From Table 2, of the 238 firms surveyed, 205 provided valid responses, representing an 86% response rate. Of the 48 licensed upstream petroleum operators, 17 operators indicated that they specifically initiated and engaged in technology, skills, and knowledge transfers and entrepreneurship development with local firms. This reflects a focused subset of respondents, critical for the study's analysis of how local content policies drive these key outcomes. The remaining 31, however, did not provide responses and were excluded from the final analysis.

Table 1 Variable Operationalisation.

S#	Variables	Measurement	Label	Scale	Sources
		LCR promoted local entrepreneurs' participation in upstream petroleum operations	LBED1	5-point Likert scale: 1 to 5	Ablo (2015); Amoako-Tuffour et al. (2015); Hunter (2014); Ihua et al. (2011); Adedeji et al. (2016).
		LCR has led to incorporation of new businesses	LBED2	5-point Likert scale: 1 to 5	Ablo (2015); Amoako-Tuffour et al. (2015); Hunter (2014); Ihua et al. (2011); Adedeji et al. (2016).
		Business ownership or participation registration is friendly	LBED3	5-point Likert scale: 1 to 5	Ablo (2015); Amoako-Tuffour et al. (2015); Hunter (2014); Ihua et al. (2011); Adedeji et al. (2016).
1	Technology, Knowledge, & Skills Transfers to Local Business and Entrepreneurship Development	LCR promoted engagement of local subcontractors in the supply and procurement input materials & services	LBED4	5-point Likert scale: 1 to 5	Ablo (2015); Amoako-Tuffour et al. (2015); Hunter (2014); Ihua et al. (2011); Adedeji et al. (2016).
		Effectiveness or satisfaction of Government policies towards enhancing local firms' participation in the oil & gas activities	LBED5	5-point Likert scale: 1 to 5	Ablo (2015); Amoako-Tuffour et al. (2015); Hunter (2014); Ihua et al. (2011); Adedeji et al. (2016).
		LCR promoted in digenous business ownership	LBED6	5-point Likert scale: 1 to 5	Ablo (2015); Amoako-Tuffour et al. (2015); Hunter (2014); Ihua et al. (2011); Adedeji et al. (2016).
		LCR has led to the registration of more subcontractors	LBED7	5-point Likert scale: 1 to 5	Ablo (2015); Amoako-Tuffour et al. (2015); Hunter (2014); Ihua et al. (2011); Adedeji et al. (2016).
		LCR promoted local entrepreneurship	LBED8	5-point Likert scale: 1 to 5	Ablo (2015); Amoako-Tuffour et al. (2015); Hunter (2014); Ihua et al. (2011); Adedeji et al. (2016).
		Local content requirements have led to an increase in foreign participation in the value chain activities	SEC1	5-point Likert scale: 1 to 5	Gbadago et al. (2023); Esteves & Barclay (2011); Asiago (2016).
2	Collaborative Engagements	LCR attracted more investments by foreign operators since its introduction	SE2	5-point Likert scale: 1 to 5	Gbadago et al. (2023); Esteves & Barclay (2011); Asiago (2016).
		LCR have made my firm secure increased business activities	SE3	5-point Likert scale: 1 to 5	Gbadago et al. (2023); Esteves & Barclay (2011); Asiago (2016).
		Capital requirement regulation is not prohibitive	EGDPE1	5-point Likert scale: 1 to 5	Tordo et al. (2013); Suleman & Zaato (2021); Heim et al. (2023).

Table 1 (continued)

S#	Variables	Measurement	Label	Scale	Sources
3	Government Policy Effectiveness	Monitoring and regulation are strictly enforced by responsible authority	EGDPE2	5-point Likert scale: 1 to 5	Tordo et al. (2013); Suleman & Zaato (2021); Heim et al. (2023).
		There is compliance and enforcement of laws and regulations	EGDPE3	5-point Likert scale: 1 to 5	Tordo et al. (2013); Suleman & Zaato (2021); Heim et al. (2023).
		LCR promoted local entrepreneurs' investments in upstream petroleum activities	EGDPE4	5-point Likert scale: 1 to 5	Tordo et al. (2013); Suleman & Zaato (2021); Heim et al. (2023).
		Law and regulation is complied with by all operators and contractors	LCR1	5-point Likert scale: 1 to 5	Hanlin & Hanlin (2012); Adedeji et al. (2016); Amoako-Tuffour et al. (2015).
4	Local Content Requirements	The sector participation regulation is friendly	LCR2	5-point Likert scale: 1 to 5	Hanlin & Hanlin (2012); Adedeji et al. (2016); Amoako-Tuffour et al. (2015).
		Local content requirements have led to the transfer of technology	LCR3	5-point Likert scale: 1 to 5	Hanlin & Hanlin (2012); Adedeji et al. (2016); Amoako-Tuffour et al. (2015).
		Local content requirements have led to increased investment by Ghanaian	LCR4	5-point Likert scale: 1 to 5	Hanlin & Hanlin (2012); Adedeji et al. (2016); Amoako-Tuffour et al. (2015).
		LCR promoted recruitment and or engagement of the local labour	ICPS1	5-point Likert scale: 1 to 5	Bloch & Owusu, 2012; Ablo (2015); Suleman & Zaato (2021).
5	In-Country Production Spending	Local content requirements have led to procurement of locally available input materials	ICPS2	5-point Likert scale: 1 to 5	Bloch & Owusu, 2012; Ablo (2015); Suleman & Zaato (2021).
		LCR promoted transfer of skills to the local labour force	ICPS3	5-point Likert scale: 1 to 5	Bloch & Owusu, 2012; Ablo (2015); Suleman & Zaato (2021).

Author(s) Compilation based on Literature.

Table 2 Distribution of Population and Sample.

S/N	Entity/Unit	Registered	Sample Surveyed	Valid Data
1	Licensed Upstream Operators	68	48	48
2	Subcontractors and Support Providers	402	190	157
	Total	**470**	**238**	**205**
	Analysed as:			
3	Operators that Engaged in Technology, Skills & knowledge transfers and entrepreneurship Development with Local Firms	68	48	17
4	Others	0	0	31

Source: Survey Results.

Sampling procedure. In order to analyze the relationship between local content requirements, technology transfers, and entrepreneurship development in Ghana's upstream petroleum sector, a simple random sampling technique was employed. Following Gbadago et al. (2023) approach, Excel's RAND function was used to randomly select participants from the firms, ensuring equal participation opportunities, minimizing bias, and enhancing the representativeness of the sample. This method ensured that both local and foreign firms involved in local content policy implementation were adequately represented, aligning with Bryman (2016), who advocates for random sampling in diverse populations.

The study targeted senior managers and representatives involved in local content implementation, technology transfer, and entrepreneurship development. By focusing on key departments such as finance, local content management, supply chain, and engineering, the study captured relevant technical and financial perspectives. This respondent selection ensured in-depth insights into how local content policies impact firm-level processes, as supported by Kazzazi & Nouri (2012).

Out of the 238 firms selected, 205 valid responses were obtained, yielding an 86% response rate. This high response rate facilitated a robust and reliable analysis of the sector. The use of a comprehensive sampling frame ensured broad representation, which is critical for drawing accurate conclusions about how local content policies influence technology transfers and entrepreneurship development, as highlighted by Sarantakos (2005) and Sola (2014). The combination of random sampling and targeted respondent selection provided a strong foundation for assessing the impact of local content requirements on technology transfer and entrepreneurship in Ghana's upstream petroleum sector.

Ethical considerations. This study adhered to strict ethical guidelines in line with institutional and international standards (Resnik, 2018; Bryman, 2016). Informed consent was obtained from all participants, who were fully informed of the study's purpose, their role, and their right to withdraw at any time without consequences, ensuring voluntary participation (Flick, 2018; Beauchamp & Childress, 2013). Also, confidentiality and anonymity were maintained by anonymizing participants' data using unique identifiers, with no personally identifiable information recorded. Data were securely stored and accessible only to the research team, ensuring compliance with data protection regulations (GDPR, 2016; Saunders et al., 2015).

The principle of non-maleficence was observed, with survey questions designed to avoid distress. Participation was voluntary and free of coercion, allowing respondents ample time to decide on their involvement (Mertens, 2015; Sarantakos, 2005). Additionally, data integrity and transparency were upheld, ensuring the accuracy and unbiased reporting of findings. Participants were informed of the intended use of their data (Bryman, 2016). It should be noted that the data for this study constitute part of a larger dataset collected as part of the corresponding author's PhD study at the University of Cape Coast Business School. This data also forms the basis for a series of publications developed from the PhD work.

The study was approved by the Institutional Review Board (IRB) of the University of Cape Coast, which ensured compliance with ethical standards, particularly in protecting participants and handling sensitive data (Wiles, 2012). Efforts to minimize bias through random sampling and anonymous data collection enhanced the objectivity and generalizability of the results (Field, 2018). Overall, these ethical considerations ensured the protection of participants while contributing to valuable insights on local content requirements, technology transfers, and entrepreneurship development in Ghana's upstream petroleum sector.

Data analysis and variable relationships. Data were analyzed using descriptive statistics and factor analysis to extract meaningful insights and establish relationships between the variables. Descriptive statistics provided an overview of the key trends, patterns, and distributions within the dataset, while analytical methods, such as component factor analysis and reliability testing, were employed to examine the structure of the data and the relationships among the variables (Field, 2018). The factor analysis was conducted in stages.

For instance, the reliability and validity of the observed items were assessed to ensure that the questionnaire items adequately measured the underlying constructs. Cronbach's alpha was used to evaluate internal consistency, ensuring that the items were reliable indicators of their respective constructs. A Cronbach's alpha value of 0.70 or higher was deemed acceptable, while factor loadings above 0.50 were considered statistically significant, confirming the robustness of the model (Hair et al., 2010). The measurement model validated the dimensional structure of the constructs, ensuring that each variable, such as local content compliance, technology transfer, and entrepreneurship development, was accurately represented by the observed data.

The factor analysis focused on ascertaining the extent to which local content compliance influenced technology transfer and entrepreneurship outcomes and the relationship thereon (Kline, 2015). The approached analytical procedure was particularly important for understanding how local content policies contribute to entrepreneurial growth and technology diffusion within Ghana's upstream petroleum sector.

The methodological steps taken in this study ensured that the findings were both statistically robust and theoretically grounded. Thus, by using reliable measurement instruments and appropriate statistical techniques, the study was able to make meaningful contributions to the ongoing discourse on local content, technology transfer, and entrepreneurship development in resource-rich economies. Overall, the results provide actionable insights for policymakers and industry stakeholders seeking to

Table 3 Reliability, Correlations and Exploratory Factor Analysis Results.

Variables	CA	CR	AVE	Correlation Co-efficient	KMO	Chi-Square	Sig.
Technology, Knowledge, & Skills Transfers to Local Business and Entrepreneurship Development	0.932	0.916	0.582	0.166–0.700	0.858	677.90	0.000
Collaborative Engagements	0.931	0.962	0.894	0.201–0.507	0.858	1,626.82	0.000
Government Policy Effectiveness	0.764	0.843	0.580	0.200–0.500	0.835	2,114.60	0.000
Local Content Requirements	0.825	0.796	0.500	0.358–0.742	0.927	2.421.13	0.000
In-Country Production Spending	0.700	0.864	0.689	0.002–0.138	0.801	455.04	0.000

Source: Survey Results.

foster sustainable economic development through local content initiatives.

Results of the study

Table 3 presents the results for reliability, correlation, and exploratory factor analysis (EFA), including the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity. The findings affirm the reliability and validity of the constructs used to measure the impact of local content requirements and associated factors on technology transfer and entrepreneurial development in Ghana's upstream petroleum sector. Cronbach's Alpha (CA) values ranged from 0.700 to 0.932, while composite reliability (CR) values, all near 1, indicate strong internal consistency (Nunnally, 1978; Hair et al., 2010). Average variance extracted (AVE) ranged from 0.500 to 0.894, demonstrating that each construct effectively captures relevant variance, with collaborative engagements showing particularly high explanatory power (Hair et al., 2014).

The correlation coefficients reveal that technology transfer (0.166–0.700) and local content requirements (0.358–0.742) have the strongest relationships, indicating their significant roles in promoting local entrepreneurial development. In contrast, in-country production spending showed weaker correlations (0.002–0.138), suggesting limited impact and the potential need for enhanced policy enforcement. In addition, the sampling adequacy (KMO values 0.801 to 0.927) and significant Bartlett's Test results ($p < 0.001$) confirm the suitability of factor analysis. Local content requirements and government policy effectiveness displayed high Chi-Square values, underscoring their importance in facilitating technology adoption and business engagement. These results provide the quality assurance for the factor analysis.

Accordingly, the exploratory factor analysis was performed, which produced the communalities, eigenvalues, and scree plot statistics, providing essential insights into the factor structure and suitability for confirmatory factor analysis (CFA). Extraction communalities, representing the variance each variable contributes to the extracted factors, ranged from 0.631 to 0.952. These values exceed the commonly accepted threshold of 0.40, suggesting that each variable has a strong fit within the factor model. Low communality scores would indicate variables that do not align well with the latent factors and were excluded from the model. The high scores across variables affirm their alignment with the constructs.

Eigenvalues, which measure the amount of variance explained by each factor, exceeded the benchmark value of 1.0 for the retained factors, indicating that these factors hold a meaningful proportion of the total variance in the dataset. When fixed at five factors and rotated, the analysis showed that these five factors collectively explain 85.195% of the total variability. This high percentage confirms the factor structure's robustness and supports the conclusion that five core influences shape the constructs related to local content requirements, in-country production spending, technology transfer, and entrepreneurial development in Ghana's upstream petroleum sector.

The scree plot (Fig. 2) visually supports the factor selection. It displays a distinct 'elbow' after the fifth factor, aligning with the chosen factor cutoff. The steep decline after the fifth eigenvalue reinforces the decision to retain these five factors, as subsequent factors contribute only minimal variance, suggesting diminishing explanatory value. This combination of communalities, eigenvalues, and the scree plot thus validates the five-factor model as an accurate representation of the underlying structure and confirms that the selected variables effectively capture the study's focal constructs.

The confirmatory factor analysis (CFA) results are reported in Table 4, with all factor loadings exceeding the benchmark value of 0.60, except for items LBED8 and LCR4, which scored 0.521 and 0.556, respectively. As recommended by Nikolchenko and Lebedeva (2017) and Gbadago et al. (2023), these indicators with factor loadings below 0.60 were retained to maintain conceptual focus and enhance content validity. The factor loading results validate the constructs of technology transfers, collaborative engagements, government policy effectiveness, local content requirements, and in-country production spending, demonstrating their roles in Ghana's upstream petroleum sector. technology transfers show strong factor loadings, with values up to 0.955 for items like 'LCR promoted local entrepreneurs' participation,' indicating LCR's positive impact on local entrepreneurship. Collaborative engagements also displayed high consistency, with loadings from 0.893 to 1.008, underscoring the role of foreign partnerships in expanding local business opportunities.

Government policy effectiveness loadings ranged from 0.603 to 0.947, with high values for regulatory support, indicating that effective policy and regulation bolster local involvement. Local content requirements loadings between 0.556 and 0.866 confirm that LCR policies encourage technology transfer and local investment. Lastly, in-country production spending loadings from 0.631 to 1.054 highlight how spending mandates promote local labour engagement and skill transfer. Overall, these findings affirm that collaborative engagements, regulatory enforcement, and local spending are crucial for driving technology transfer and entrepreneurship, providing actionable insights for strengthening local content policies and maximizing economic impact.

Discussion of results

The study's findings emphasize the significant role of local content requirements in promoting technology transfer, knowledge and skill acquisition, and entrepreneurship development within Ghana's upstream petroleum sector, which aligns closely with the conceptual framework presented in Fig. 2. The framework postulates that LCRs when supported by collaborative engagements and effective policy enforcement can facilitate technology transfers and entrepreneurship development.

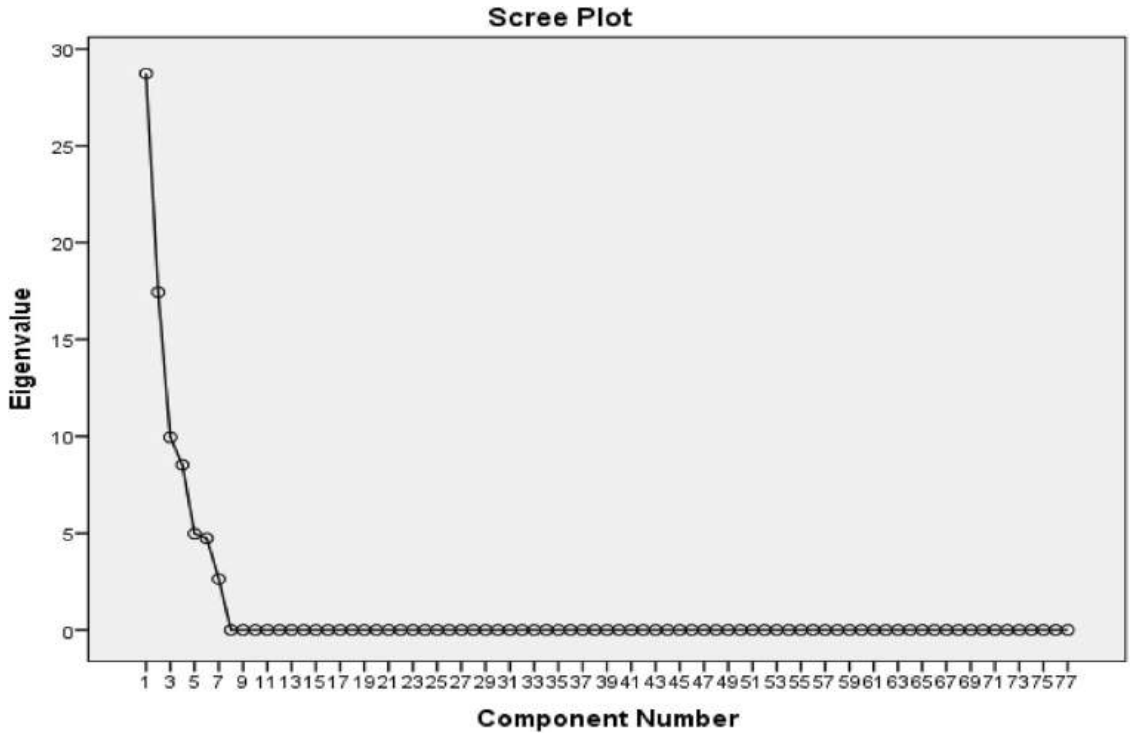

Fig. 2 Scree Plot. Source: Survey Results.

Table 4 Component Factor Analysis Results.

S#	Variables	Measurement	Label	Factor Loadings
1	Technology, Knowledge, & Skills Transfers to Local Business and Entrepreneurship Development	LCR promoted local entrepreneurs' participation in UPO	LBED1	0.955
		LCR has led to incorporation of new businesses	LBED2	0.917
		Business ownership or participation registration is friendly	LBED3	0.784
		LCR promoted engagement of local subcontractors in the supply and procurement OF input materials & services	LBED4	0.747
		Effectiveness or satisfaction of Government policies towards enhancing local firms' participation in the oil & gas activities	LBED5	0.721
		LCR promoted Indigenous business ownership	LBED6	0.707
		LCR has led to the registration of more subcontractors	LBED7	0.664
		LCR promoted local entrepreneurship	LBED8	0.521
2	Collaborative Engagements	LCR has led to an increase in foreign participation in the value-chain activities	SEC1	1.008
		LCR attracted more investments by foreign operators since	SE2	0.932
		LCR have made my firm secure increased business activities	SE3	0.893
3	Government Policy Effectiveness	Capital requirement regulation is not prohibitive	EGDPE1	0.947
		Monitoring and regulation are strictly enforced	EGDPE2	0.782
		There is compliance and enforcement of laws and regulations	EGDPE3	0.669
		LCR promoted local entrepreneurs' investments in UPO	EGDPE4	0.603
4	Local Content Requirements	Law and regulation are complied with by all operators	LCR1	0.866
		The sector participation regulation is friendly	LCR2	0.697
		LCR has led to the transfer of technology	LCR3	0.673
		LCR has led to increased investment by Ghanaian	LCR4	0.556
5	In-Country Production Spending	LCR promoted recruitment and or engagement of the local labour	ICPS1	1.054
		LCR has led to procurement of locally available input materials	ICPS2	0.748
		LCR promoted transfer of skills to the local labour force	ICPS3	0.631

Source: Survey Results.

By demonstrating strong reliability (Cronbach's Alpha between 0.700 and 0.932) and internal consistency (CR values approaching 1), the constructs proved suitable for examining the impacts of LCRs and in-country spending mandates on technology transfer, knowledge and skill acquisition, and entrepreneurship development. Theoretical perspectives such as the social exchange theory, linkage and spill-over effects, and the concept of resource dependency provide a comprehensive understanding of the observed outcomes, offering insights into the mechanisms through which LCR policies affect local participation in the petroleum sector.

Impact of local content requirements and collaborative engagements. The results underscore the efficacy of LCRs and collaborative engagements in facilitating technology and knowledge transfers to local businesses, aligning with findings in similar contexts (Ablo & Overa, 2015; Ihua et al., 2011). Technology transfer correlation coefficients ranging from 0.166 to 0.700, and local content requirements from 0.358 to 0.742, highlight the positive impact of these policy tools in promoting local entrepreneurial development. According to the social exchange theory, collaborative engagements, such as partnerships between foreign and local firms, create a mutually beneficial environment fostering technology transfer. This theory posits that foreign operators gain legitimacy, while local businesses access knowledge, skills, and networks, enhancing their capabilities (Asiago, 2017; Ablo, 2015).

The strong KMO values (0.801 to 0.927) and significant Chi-square statistics for Bartlett's Test validate the suitability of factor analysis in examining these relationships. These indicators support the alignment of the constructs with the conceptual framework, which postulates that LCRs, when coupled with government policy effectiveness, enhance collaborative engagements, thus directly contributing to technology and skills transfers.

Government policy effectiveness and entrepreneurship development. Government policy effectiveness demonstrated moderate correlation coefficients (0.200–0.500) with technology transfer and entrepreneurial development outcomes. These values suggest that while LCR policies set a foundation for local engagement, their success largely depends on policy enforcement. This aligns with resource dependency theory, which emphasizes the need for regulatory frameworks to balance the power dynamics between foreign operators and local entities (Gbadago et al., 2023). Effective policy enforcement can mitigate resource dependency, ensuring that foreign operators contribute to local industrial capacity building.

The moderate factor loadings for government policy effectiveness items (0.603 to 0.947) reflect varied perceptions of regulatory support, highlighting challenges with enforcement and capacity development. These findings resonate with prior studies emphasizing the importance of comprehensive regulatory frameworks in advancing local content objectives (Suleman & Zaato, 2021). Enhanced policy enforcement could address gaps in technology and skills transfers, as well as ensure a stable regulatory environment that encourages more substantial local business engagement.

In-country production spending: limited impact and policy implications. The correlation coefficients for in-country production spending (0.002–0.138) reveal a limited effect on entrepreneurship development, suggesting that current spending mandates may not be optimally enforced or impactful. This result aligns with Suleman and Zaato's (2021) findings on the reluctance of petroleum operators to fully comply with spending mandates. Theoretical perspectives on linkage and spill-over effects suggest that weak enforcement of in-country spending can hinder the local economy's ability to benefit from upstream petroleum activities, which does not align with objectives of L.I.2204.

The moderate to high factor loadings for in-country production spending (0.631 to 1.054), which suggest that existing policies are effective in promoting local supplier participation and procurement practices. Continued support and fine-tuning of these mandates could help maximize local value retention, encourage further technology spill-overs, and amplify socio-economic benefits, as outlined in the conceptual framework.

Validation of conceptual framework and theoretical implications. The conceptual framework, which posits that local content requirements, collaborative engagements, and policy effectiveness facilitate technology transfer and entrepreneurship development, is validated by the results. High communalities and eigenvalues exceeding the threshold of 1, and a cumulative explained variance of 85.195%, suggest that the selected constructs robustly represent the study's focal themes. The scree plot further confirms the five-factor model, highlighting the importance of these constructs as foundational to local content policy impacts on the upstream petroleum sector.

The findings support the application of linkage and spill-over theory and social exchange theory in the Ghanaian context, where local content policies are positioned to drive industrial growth and foster sustainable economic benefits. The observed relationships reinforce the relevance of collaborative engagements and in-country spending mandates in bridging the resource dependency gap, fostering mutually beneficial partnerships between foreign operators and local businesses.

Policy and practical implications and recommendations. The findings of this study reinforce the importance of local content requirements and in-country production spending mandates as policy tools to foster technology transfer, knowledge exchange, and entrepreneurship within Ghana's upstream petroleum sector. The analysis reveals that technology transfer and collaborative engagements between foreign operators and local firms play a pivotal role in enhancing local capacities and driving socio-economic growth. Despite their positive impacts, government policy effectiveness and the enforcement of in-country production spending mandates emerge as areas requiring strengthened oversight to maximize these benefits.

The study's insights have meaningful policy implications. Strengthened regulatory enforcement and capacity-building initiatives can support local firms in becoming more competitive participants in the value chain. Policymakers are encouraged to design mechanisms that incentivize operators to fulfil their LCRs obligations more comprehensively, particularly in technology and skills transfers to local entities. Additionally, clear, consistent policy guidelines on in-country spending mandates will promote local sourcing of goods and services, ensuring that economic benefits flow to local enterprises, thereby enhancing Ghana's industrial capacity.

Contributions. This study makes several contributions to the literature on local content policy, resource dependency, and technology transfer in resource-rich economies. By examining the interrelationships among LCRs, in-country production spending, and local business development, it advances our understanding of how local content policies shape technology transfers and entrepreneurship within a developing economy context. The use of a rigorous analytical framework, which includes exploratory and confirmatory factor analyses, establishes a robust foundation for understanding the impact of collaborative engagements on socio-economic outcomes in the Ghanaian petroleum sector.

The study's novelty lies in its integration of multiple theoretical perspectives, including linkage, spill-over effects, and social exchange theories, to offer a holistic view of local content policies in emerging economies. The conceptual framework developed here further contributes to the field by synthesizing these theories and applying them to a model that is directly relevant to Ghana's unique resource-driven economy. This study's findings have the potential to inform similar policy contexts in other emerging economies with resource-based industries, promoting an

understanding of how local content policies can be effectively harnessed for sustainable development.

Recommendations. Based on the study's findings, the following recommendations are proposed to enhance the effectiveness of local content policies and maximize their benefits in Ghana's upstream petroleum sector namely:

First, the Ghanaian government, particularly through the Petroleum Commission, should intensify policy enforcement by establishing rigorous monitoring and compliance mechanisms. Periodic audits, enforcement of penalties for non-compliance, and transparent reporting of industry compliance rates could improve adherence to local content requirements, thereby ensuring the intended benefits reach local businesses.

Second, capacity-building programs are essential to equip local firms with the technical and managerial expertise necessary to meet international operational standards. Collaborative efforts between the government and industry stakeholders could drive initiatives that provide targeted skills training and managerial development for local enterprises. By fostering this enhanced capacity, local firms would be better positioned to meet foreign operators' requirements, increasing their competitiveness and expanding their role in the petroleum sector.

Also, encouraging collaborative engagement between local and foreign firms can be an effective way to advance technology transfer and local business development. Incentivizing such partnerships through tax incentives, subsidies, or public recognition programs for firms actively contributing to local business growth would promote knowledge and skills transfer. This, in turn, could drive foreign firms to invest further in local capacity development initiatives, creating a more sustainable and inclusive sector.

Finally, a comprehensive local content master plan should be developed to provide a clear framework and specific benchmarks for technology transfer, skills development, and local sourcing. Such a plan would align the sector's objectives with national development goals, guiding policymakers and stakeholders in maximizing local content outcomes over the long term.

Limitations and future research directions. Despite its contributions, this study has some limitations that suggest areas for future research. First, the sample was limited to firms operating within the Ghanaian upstream petroleum sector, which may limit the generalizability of the findings to other contexts or sectors. Future studies could explore similar relationships in downstream petroleum or other resource-driven industries to examine if the observed effects hold in different sectors.

Second, while the study employs robust quantitative methods, a qualitative approach may provide additional insights into the nuanced interactions between foreign operators and local firms. Future research could adopt mixed methods to gain a deeper understanding of these relationships, particularly regarding specific challenges that local firms face in capturing technology and skills transfers.

Finally, this study focused on technology transfer and entrepreneurial development outcomes, but further research could explore the long-term socio-economic impacts of LCRs, such as job creation, industrialization, and poverty alleviation. Investigating these outcomes over time would provide a more comprehensive understanding of the broader impacts of local content policies on national development. Additionally, future studies could explore the influence of macroeconomic factors, such as exchange rates or global oil prices, on the effectiveness of LCRs, shedding light on external factors that shape policy outcomes.

In conclusion, this study underscores the transformative potential of well-enforced local content policies. By addressing the identified limitations and following these research directions, future studies can build on this work, contributing to a deeper, more nuanced understanding of local content policies and their impact on sustainable development.

Data availability

The data supporting this study's findings are available upon reasonable request, subject to ethical and legal considerations.

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Author Contributions

The author is responsible for the study's conception, design, methodology, data analysis, and manuscript preparation. The author has reviewed and approved the final version for publication.

Competing interests

The author declares no competing interests.

Ethical approval

All procedures performed in this study were conducted in accordance with accepted ethical research standards, as outlined in 1964 Declaration of Helsinki and its subsequent amendments. Ethical clearance (referenced: UCCIRB/CHLS/2021/01) was obtained from the University of Cape Coast Institutional Review Board (UCCIRB) prior to the commencement of data collection. This clearance provided the ethical foundation for the study, which formed part of the author's PhD research at the University of Cape Coast, Cape Coast.

Informed consent

All participants were informed about the study's purpose, procedures, and their rights, including voluntary participation and confidentiality. Written or verbal consent was obtained in accordance with ethical guidelines.

Additional information

Correspondence and requests for materials should be addressed to Frank Yao Gbadago.