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Business processes and information systems in the Ghana cocoa supply chain: A survey study

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ABSTRACT

The Ghana cocoa industry contributes substantially to the total world cocoa production and provides livelihoods to more than a quarter of the population. Although cocoa holds a leading position in the Ghanaian economy, no explicit effort has been made in modelling and documenting the business processes of the cocoa supply chain and the role that IT plays in supporting those processes. Hence, it is difficult to identify the current obstacles in adopting IT in the Ghana cocoa sector, and likewise, enhance the alignment of the business processes along the supply chain and the underlying IT systems. To address this issue, this article presents the results of a survey study to the current business processes of the cocoa supply chain and the underlying IT systems in Ghana. The survey study has been conducted with 56 individuals from the three key sets of actors from the sector, which are cocoa farmers, cocoa traders and the Ghana cocoa board. Based on the results of the survey study, we provide formal business process models of these actors and describe the role IT currently plays in supporting the business processes. We report on the lessons learned together with the obstacles and thus aim to pave the way for further development and enhancement of the business processes as well as the adopted IT.

1. Introduction

Cocoa contributes substantially to the world commodity market and its global relevance cannot be disputed. Cocoa is the main raw material for the global chocolate sector which was worth $150bn in 2014 (Financial Times, 2015). Globally, 40–50 million people depend on the cocoa supply chain for their livelihoods (Beg et al., 2017). As the second largest producer and exporter of cocoa beans in the world, Ghana's cocoa industry accounts for 20 % of the global cocoa production (Monastyrnaya et al., 2016). Currently, the sector accounts for 30 % of the total export earnings in the country (Monastyrnaya et al., 2016). In addition, the Ghana Cocoa Supply Chain (GCSC) provides income for six million people, representing 30 % of the population in Ghana (Anthonio and Aikins, 2009; Gockowski et al., 2011; USDA, 2012).

The GCSC contains diverse stakehodlers who have different roles and differ in their needs, backgrounds, and the conditions under which they operate. Farmers are responsible for growing and harvesting of cocoa beans. Cocoa traders, formally called the Licensed Buying Companies (LBCs), oversee the domestic purchasing and transporting of bagged cocoa beans. The civil societies, on the other hand, contribute to advocating for transformative projects in the GCSC. The government controls and supervises, through its Ghana Cocoa Board (COCOBOD), the activities of the stakeholders in the GCSC (Antwi Opoku et al., 2015).

Although cocoa holds a leading position in the Ghanaian economy, no explicit effort has been made in modelling and documenting the business processes of the cocoa supply chain. Also, little is known about the adoption of IT (Information Technology) systems in the Ghana cocoa sector. Hence, it is difficult to identify the current obstacles in adopting IT, and likewise enhance the alignment of the business processes along the Ghana cocoa supply chain.

In addition, lack of access to information has been a concern to some of the actors of the GCSC. Information is a source of power, and thus inequality and exclusion affect the actors negatively (Gereffi et al., 2005; Laven, 2010). Conversely, sharing of information across the supply chain helps to facilitate coordination among supply chain actors and enhance efficiency (Lee et al., 1998; Gereffi et al., 2005). In GCSC, actors downstream the supply chain, particularly LBCs, appear to own most of the information. The farmers, from whom nearly all the information is collected, their cooperatives and the sector regulator COCOBOD have less and sometimes no access to the information. Therefore, the GCSC is characterized by the unfair distribution of value and inefficient coordination of operations.

The main objective of this study is to formally model the business

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processes and describe the underlying IT systems in the GCSC so that the state-of-the-art becomes well known and well understood. To achieve this objective, four Research Questions (RQ) have been formulated, which are:

RQ1: Who are the key actors of the GCSC and how they relate to each other?

RQ2: What are the current business processes of the actors?

RQ3: What are the underlying IT systems used by the actors? and,

RQ4: How do the IT systems support the business processes?

To answer these questions, we have carried out a systematic approach using both survey and design science research. We report on the outcome of the study and present the lessons learned. The remainder of this paper is organized as follows. In section 2 we provide background information relating to business processes and IT. In section 3 we present the research methodology that we have adopted. Section 4 describe the results and discussions, which include the formal business process models and the description of the supporting IT systems. In section 5 we provide concluding remarks.

2. Background

2.1. Ghana cocoa supply chain

The GCSC is like any other production and marketing industry; it is characterized by a network of actors that join forces to complete the activities that are needed to deliver quality cocoa beans for export. The actors contribute to the production, transportation and marketing of cocoa. Awuah-Gyawu et al. (2015) identified three major actors in GCSC: (1) cocoa farmers (2) LBCs and (3) COCOBOD. There are about 800,000 cocoa producing households in Ghana (Ghana Statistical Service, 2014). The LBCs have District Managers (DMs) who live in the cocoa growing districts. These DMs also have marketing clerks formally called the Purchasing Clerks (PCs). PCs receive funds from their respective LBCs through their DMs and purchase cocoa beans from farmers (Anthonio and Aikins, 2009; Awuah-Gyawu et al., 2015). In 2013/14 cocoa season, the number of LBCs were 41, but only 32 actively purchased cocoa in that season (Ghana COCOBOD, 2014). COCOBOD is a government institution that controls and supervises the production and marketing of cocoa and performs its responsibilities with the support from its five key subsidiaries (Essegbey and Ofori-Gyamfi, 2012). The subsidiaries include; Cocoa Marketing Company (CMC), Quality Control Company Limited (QCCL), Cocoa Research Institute of Ghana (CRIG), Cocoa Health Extension Division (CHED) and Seed Production Division (SPD).

2.2. Business processes

In the context of agri-food supply chains, business processes are a set of interrelated business activities involving the production, distribution and transaction of goods and services across a supply chain. The processes involve autonomous organizations, such as producers, traders, distributors and retailers (Verdouw et al., 2010). From an organization perspective, business processes are directly linked to specific business outcomes (Davenport and Short, 1998; Aguilar- Saven, 2004). In a supply chain, a business process in one organization is linked directly with business processes in other organizations: for example, the business processes of a farmer in the GCSC are typically linked to the business processes of an LBC (which is an entirely different organization) since a farmer typically sells his produce to an LBC.

In a more technical sense, Dumas et al. (2013) describe business process as a chain of activities, tasks, events and decisions. Activities represent either a single unit of work, which is a task, or interconnected set of tasks. Events denote things that happen without a duration, such as the arrival of a message or a launch of a process. Decisions, on the other hand, are the choices made at a particular point in the process flow and are presented by gateways. A typical example of a business process in GCSC is the purchase of cocoa beans by PCs. The arrival of the cocoa season is an event, which leads to a number of tasks to be performed and decisions to be made by PCs. In addition, a business process may involve a number of actors in charge of executing the various activities and making decisions (Dumas et al., 2013). These actors can be people, software systems, business units or entire organizations.

In the business process management discipline, business processes are normally depicted as diagrams using visual representation methods. This process of presentation is an essential part of business process modelling (Dumas et al., 2013; Kassahun, 2017). Business process modelling is an essential part of business process management, which deals with integrating and redesigning of the business processes of a supply chain (Verdouw et al., 2010).

There are many modelling notations and techniques for presenting business processes. The frequently used techniques include flowchart diagrams, dataflow diagrams, Business Process Modelling Notation (BPMN), Event- driven Process Chain (EPC) and UML (Unified Modelling Language) activity diagrams. The widely used technique of presenting business processes is BPMN (OMG, 2011). BPMN enables depicting graphically the business activities, the events that triggered the activities, the flow of information and the decision logic. BPMN provides notations that are designed to be easily comprehensible to a wide-range of stakeholders, including business owners, process analysts and IT engineers (Silver and Richard, 2009).

2.3. Information systems

Information systems are used for managing and supporting business processes and are the backbone of every organization. In this paper, we adopt the conceptualization of information systems by Piccoli (2014). According to Piccoli, information systems are formal, socio-technical, organizational systems designed to collect, process, store and distribute information. An information system has four components that can be grouped into technical and social sub-systems. The technical sub-system comprises of technology and process; the social sub-system is composed of structure and people. The technology component refers to both software and hardware elements. The process component refers to business processes. The structure and people, on the other hand, refers to the organizational setup and the individuals who are part of the information system.

Information systems support the execution of business processes and can be manual (paper-based and human-intensive) or computerized (automated and IT-intensive), but mostly they are the combination of the two. Manual systems rely heavily on the social sub-system. Manual systems generally involve paper forms that are processed by employees who belong to specific organizational units. Computerized systems use IT systems that include software applications and computer hardware and execute business processes, to a large extent, autonomously.

The technology component in this paper refers to the IT systems used by the actors in the GCSC. This includes IT systems used for marketing, accounting, receiving, human resources management and procurement systems. Enterprise Resource Planning (ERP) systems, which include procurement, sales and marketing, human resource, and accounting are the most important IT system for supply chain management (Tekinerdogan, 2014). The functional structure and the actors in the GCSC represent the structure and people of Piccoli's social subsystem.

3. Research design

Two major research protocols are used to address the research questions in this study. The first is a survey study based on semi-structured interviews, which is used to address all four research questions. The second is design-based research, which is used to address RQ2 using formal business process models.

3.1. Interview-based survey study

Survey study allows researchers to collect information that describes or explains the behaviors, attitudes, and knowledge of a population from which the target group was sampled (Pfleeger and Kitchenham, 2001; Glasow, 2005).

The survey research activities employed in the study include the design of the survey study, preparation of data collection instrument, selection of actors, validation and administration of the questionnaires, and analysis of the interview responses. The details about these steps have been highlighted in the section that follows.

3.1.1. Survey study design

The survey study design includes the specification of the goal of the study, the research questions, data requirements, study population, the nature of the data collection and the methods of the data analysis. The goals and the research questions are outlined in the introduction section of this paper. Data requirements include the survey data and other qualifying data from secondary data sources. The study population constitutes 56 individuals from different actor groups who have been interviewed in December 2016. The analysis constitutes encoding of the interview results, quantitative analysis and formal modelling of business processes. Table 1 summarizes the design of the survey study used in this study.

3.1.2. Data collection instrument

Semi-structured questionnaires were developed based on information derived from literature about the roles and activities of the actors of GCSC. Three separate questionnaires were prepared for the three major types of actors. The questionnaires constitute pre-defined set of closed and open-ended questions, including questions about the actor's background, the current business processes and the information system (including the IT systems used) (see Appendix A). The questionnaires were printed on paper and were used to record the responses of the interviewee. The paper forms were given reference numbers for traceability purposes.

3.1.3. Actors selection

Purposive sampling technique was used as a procedure to select the actors. The technique used denote that each of the supply chain actors selected was based on their fundamental roles. For instance, at COCOBOD, the officials interviewed have in depth knowledge of the business processes and IT systems in the sector. Table 2 shows the 56 individuals interviewed, representing three different types of actors in the GCSC.

3.1.4. Validation and administration of the questionnaires

The semi-structured paper questionnaires were pretested on some selected actors from the target population in the GCSC. The concerns of these selected respondents about the questionnaires were noted and addressed in the final questionnaires used for the field work. The pretest was used to avoid inconsistencies, and check the validity and reliability of the questionnaires. The researchers adopted the supervised questionnaire administration technique based on face-to-face interviews as described by Pfleeger and Kitchenham (2001). Using this technique, first, meetings were scheduled among the target population. Second, the goal of the research, its contributions and the time required for the interviews were described to each of the interviewees. The researchers also assured the correspondents that all the information given shall be used solely for this research and will be treated confidentially. Last, the data were collected through field and office visits and face-to-face interviews. The responses were written on the paper forms of the questionnaires. With the consent of the 56 individuals, photographs were also taken to support the data collection.

Table 1
Steps for the survey study design.

Survey study activity	Descriptions
Goal	See section 1
Research questions	See section 1
Data requirements	Primary and secondary source of data
Studied population	56 individuals from GCSC
Data collection	Semi-structured interviews (open and closed questions)
Data analysis	Qualitative data analysis of actors and the modelling of business processes

Table 2
Summary of interviews.

Actor	Number of respondents
Cocoa farmers	20
LBC:	20
Purchasing Clerks (PCs)	9
District Managers (DMs)	1
Port Manager (PMs)	3
Operations Managers (OMs)	3
COCOBOD officials	
Total	**56**

3.1.5. Analysis of interview responses

The survey responses recorded on paper were digitized onto Microsoft Excel 2016. The responses were then synthesized into formal business process models using the business process modelling technique. The IT systems used by the actors were identified qualitatively and directly from the survey response. These analyses are described in detail sections 3.2 and 3.3.

3.2. Modelling business processes

The business process models presented in this research constitute the flow of activities and the interaction among the actors and the business units (collaboration) in the GCSC. In modelling the business processes the following steps were followed. First, the actors were identified directly from the Microsoft Excel file. In BPMN notations, the *BPMN pool* element represents the whole organization, whilst the *BPMN lane* element represents a business unit (a role) within the organization who is executing the activities within the lane. A lane is a sub-partition of a pool. A samaller orgaisation, mainly farmers, the whole organization is considered as a single business unit, and thus represented as a single lane; a large organization, such LBC and COCOBOD, the differnt business units within the organization are represented by their own dintinct lanes. Second, the plain business activities as described by the actors were rephrased, made consistent, and represented as BPMN tasks. Likewise, the sequence of execution of activities and the BPMN gateways, representing and choices made by the actors, were identified. The tasks, gateways and flows together represent an actor's BPMN process model. When a process model represents a number of actors (for instance, 20 cocoa farmers were sampled for the study), only the common features that are representative of the activities carried out by most of the actors are included. Last, the interactions among actors were represented using the BPMN message exchanges notation. The data associated with business activities were represented using the BPMN data object and data store notations.

3.3. Identifying IT systems

During the data collection process, the actors were made to indicate the underlying IT systems and hardware technologies used to support their business activities. Their responses were harmonized and digitized. The IT systems were then categorized by the business activities they support.

4. Results and discussion

We present in the following sub-sections the answers to each of the four research questions, and discuss the relevance and implications of the results. Section 4.1 addresses RQ1 by describing how the actors in the GCSC relate to each other. Section 4.2 addresses RQ2 by providing the business process models of the three major actors. Section 4.3 addresses RQ3 by identifying the IT systems adopted by the actors. Finally, section 4.4 addresses RQ4 by describing the alignment of IT with the business processes.

4.1. Cocoa supply chain actors and their relationships

The findings from our survey study affirmed the structure of GCSC as described in the background (see section 2.1) but also provided new information. We identified new roles among the key actors in the GCSC whose influences are valuable to consider because the actors execute key business processes in the GCSC (see section 4.2 for the details of the business processes). Within the LBCs, the survey revealed two additional roles of importance: Operations Managers (OMs) and Port Managers (PMs), besides DMs and the PCs. The survey also reaveled the specific roles of SPD and CHED divisions of COCOBOD in relation to cocoa production. SPD is in charge of supplying inputs (e.g. seedlings and fertilizers) to farmers and CHED manages the extension activities in the cocoa industry. CMC is mandated with external and internal marketing of cocoa through its Warehousing and Port Operations (WPO) division. QCCL oversees the quality of cocoa beans while CRIG focuses on research and provides specific recommendations. These findings show that the mandates of Ghana COCOBOD are carried out by specialized subsidiaries. The results further show that CMC has internal business units called *Shipping* and *WPO* that support the execution of its business processes. The business processes of these two business units are provided in section 4.2.2. These insights are crucial for broadening the knowledge about the key stakeholders and the internal structure of COCOBD, and will help improve identifying effective areas of collaboration in the cocoa industry. The identification of these key actors will not only deepen the stakeholders' understanding of the actors operating in the GCSC, but it also helps regulators and civil societies in formulating the right policies and dissemination of information.

Our study confirms the prevailing knowledge on the roles of the diverse actors: cocoa farmers maintain cocoa fields, grow cocoa, harvest and sell dried cocoa beans to PCs; PCs purchase dried cocoa beans on behalf of their respective LBCs, and sort, bag and evacuate the dried bagged cocoa beans to the DMs of their LBCs; DMs receive bagged cocoa beans from their PCs, warehouse and evacuate the cocoa beans to the nearest inland port where the cocoa beans will be received by a PM; PMs document the bagged cocoa beans and handover to WPO who then warehouses the bagged cocoa beans, prepare them for shipping by the shipping department. These findings corroborate the observations by Awuah-Gyawu et al. (2015) and Monastymaya et al. (2016). The actors and their interrelationships is depicted in conceptual model shown in Fig. 1.

4.2. Business process models

Now that we have outlined the main actors and their interrelationships we elaborate in this section the models of the business processes of the actors. The business process models illustrate the flows of activities as well as the flow of information within and among the actors.

4.2.1. Business processes of cocoa farmers

Fig. 2 shows the conceptual model of the business process performed by cocoa farmers in GCSC. The directional arrows and the numbers show the sequential flow of activities of the cocoa farmers. The business process illustrated in Fig. 2 has been translated into a formal BPMN model in Fig. 3.

The cocoa farming business process consists of five major activities: pre-planting operations, cocoa seedlings procurement (depicted as two separate BPMN tasks: requesting and receiving cocoa seedlings), planting/farm maintenance, harvest, and post-harvest activities.

The pre-planting operations comprise of a number of activities. First, the site for planting of the cocoa seedlings is selected. Then the site is cleared, an activity that may include the removal of large undesirable trees and controlled burning of the trashes referred to as 'land preparation'. This is followed by lining and pegging at recommended spacing. After that farmers plant low shading crops such as cassava, cocoyam, maize, yam with the prime objective of providing food until the cocoa starts bearing fruits and with an added function of providing shade to protect the young cocoa plants. All these activities have been collapsed collectively and depicted as *pre-planting operations* in the business process model.

Procurement of cocoa seedlings follows the pre-planting operations. Farmers go to SPD for cocoa seedlings. (Though all interviewed farmers obtained their seedlings from SPD, we observed that some farmers also raise their own seedlings.) The offices of the SPD are located close to the farmers in the cocoa growing communities. We observed that farmers are asked to produce their national identification card and thier COCOBOD passbook, and indicate the size of the land cleared before receiving the cocoa seedlings. These data are registered by the SPD. Though the provision of such data is required and relevant for identification and as a control mechanism by SPD, farmers likely have no idea how their information is stored, managed and used. There is also no known data protection plan. COCOBOD has a role in addressing this concern and enhance proper information management, and overcome the exclusion of farmers from access to infromation as stated by Gereffi et al. (2005) and Laven (2010).

The cocoa seedlings received from the SPD are planted. This activity leads to farm maintenance activities. The farm maintenance activities include weed management, mulching, management of the shade, application of fertilizer, diseases and pests control.

The cocoa is harvested when the pods turn deep yellow. The post-harvest activities start with picking the harvested cocoa pods from the ground and heaping them in a central pod breaking point. The breaking of the pod follows this activity. After this activity, the cocoa beans are fermented, generally for 6 days, and sun-dried for 6–7 days depending on weather condition. Afterwards, cocoa farmers go to the PCs for fetching empty jute sacks for bagging of the dried cocoa beans.

A farmer sells the dried bagged cocoa beans to a PC and receives a cash payment. During the payment, the PC records relevant data in the cocoa farmer's passbook as a means of record keeping. The recorded data include passbook number, crop year, date of sale, cocoa beans sold in kilograms, the LBC's license number, district name or code, society name or code, and the PC's name and signature. The information in the cocoa farmer's passbook serves as transactional data for the cocoa farmer. The business process of the cocoa farmers comes to an end when the cocoa beans are sold to the PC.

The recording of data in farmers' passbook implies that there is an exchange of transactional data between the PCs and the cocoa farmers. There may be additional datasets that are recorded by the PCs of which the farmers, once again, have no idea where those data are stored and used. This can be attributed to farmers' lack of knowledge about the value of information in thier trade relations with LBCs and inadequate information technology to manage and protect information. To help enhance the fair access to information, the LBCs, for whom the PCs work, should at least provide farmers with a summary of purchases at the end of every cocoa season. With such an infromation, the farmers will have a snapshot of their transactions, which in turn will help them to do self-performance assessment and benchmark with other farmers. The cocoa farmers could in addition be educated on how the data recorded in their passbook can be used to inform their decisions.

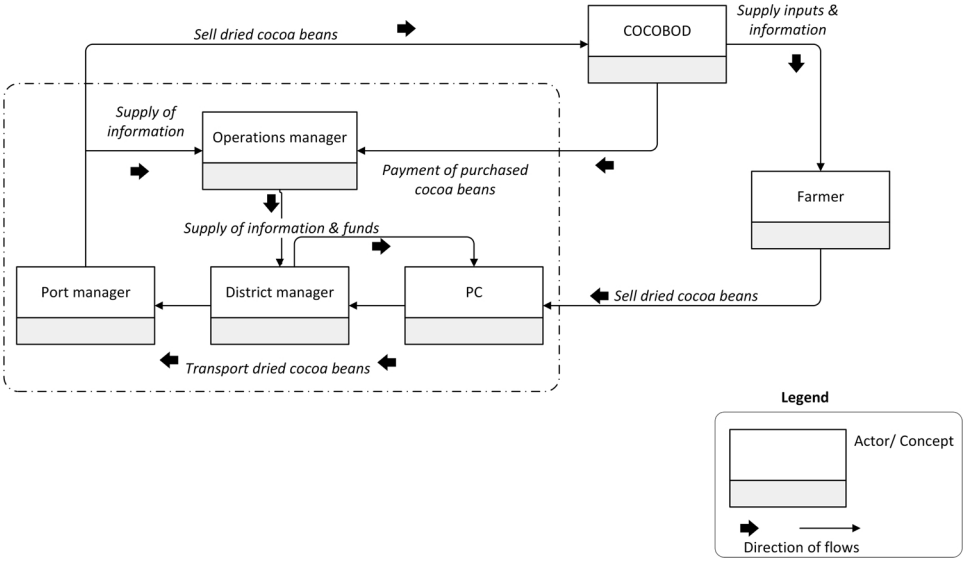

Fig. 1. Conceptual model depicting the GCSC actors and their interactions.

4.2.2. Business processes of LBCs

The business process of the LBCs is depicted using the four different business processes of the four different roles within LBCs, which are PCs, DMs, PMs and OMs. The four business processes are excuted collaboratively, and are first initiatied by the PCs and completed by the OMs.

4.2.2.1. Business process of PCs. The business process of PCs is depicted in Fig. 4. The activities of the PCs can be grouped into three: request of funds (shown as the first two tasks: request and receive funds), quality checks of cocoa beans (shown as the three subsequent tasks: check cocoa bean quality, reject cocoa beans, and accept/weigh cocoa beans), and purchase cocoa beans (the remaining tasks). The business process is initiated when PCs request funds from their DMs to purchase cocoa beans, which indicates that the collaborative business processes of the LBCs are initiated by the PCs. The PCs request funds after submitting returns on previous week purchases and receive the requested funds only when the previous week's purchases reconcile with the money received; otherwise, they are denied funds. When the request is denied, the PC must revisit his or her accounts and review the returns before placing another request for funds.

After receiving the requested funds from their DMs, the PCs use the money to purchase cocoa beans from farmers. When a farmer brings his or her cocoa for sale, PCs check the quality of the cocoa which include checking if the beans are thoroughly dried (moisture content) and free from blemishes. The responses from the PCs interviewed revealed that if the cocoa beans fail to pass the quality checks, the beans are rejected for reconditioning. The recondition process implies that the cocoa

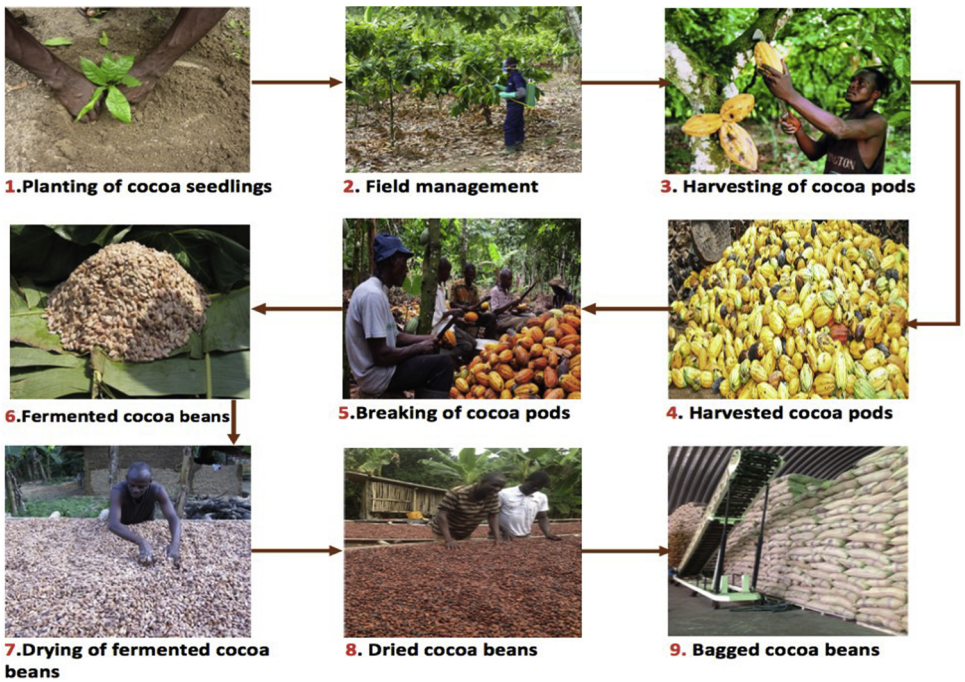

Fig. 2. Conceptual model of the business process of cocoa farmers.

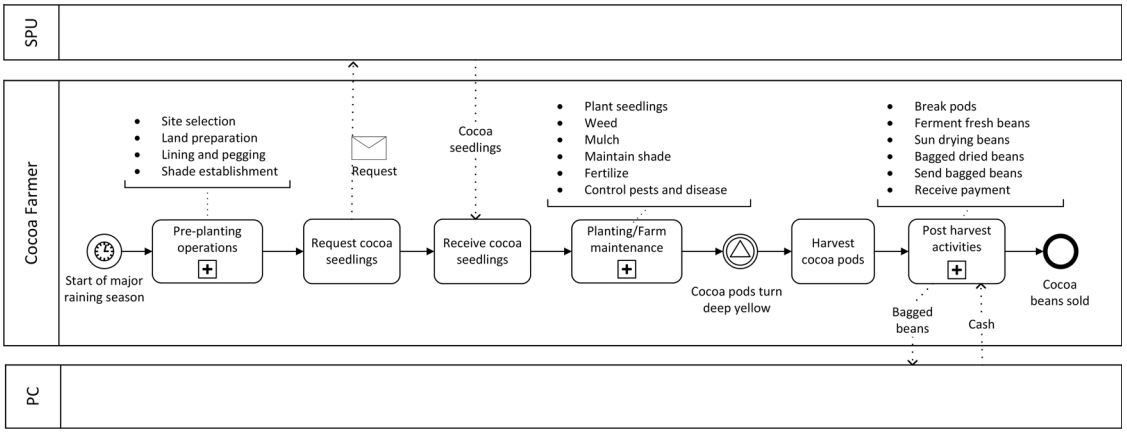

Fig. 3. Business process model of cocoa farming.

beans are sorted and are sun dried again for some few days. The responses also indicated that cocoa beans that pass the quality examination are weighed.

The farmers are paid in cash after the weighing. The PC then record the details of the purchase as described in section 4.2.1. The PC's general ledger serves as a transaction database and is used in preparing the weekly returns (shown in Fig. 4 as a data store labelled *PC general ledger*). The PC calls the responsible DM for evacuation of purchased cocoa beans from the society storage area or village to the LBC district warehouse. The business process of the PCs comes to an end when this evacuation is done.

The PCs record their transaction data on paper notebooks, which could lead to many errors and loss of data, particularly if the files are not adequately secured. The lack of digital record indicates the lack of infromation sharing and infromation asymertry. Even if the PCs want to share infromation, it is difficult for them to process the records, derive the necessary summary and benchmark information, and share the infromation back to the farmers. To overcome this difficulty, LBCs could deploy a simple software application to manage and process their data and train the PCs on how to use them. Such an application should provide other actors access to relevant data that will help them in executing their business activities and support better decision making.

4.2.2.2. Business process of DMs. The DMs business process (shown in Fig. 5) begins when the DM starts to receive dried cocoa beans from PCs. The DMs hire labourers to offload the cocoa beans. The dried cocoa beans are offloaded and packed into the district warehouse, and the offloaded quantities are recorded.

Once sizeable quantity of cocoa beans is recorded, the DM applies to QCCL (a subsidiary of COCOBOD) for grading and sealing. This activity involves sending a document to QCCL, which has offices located in the districts of the cocoa growing areas. The DM receives evacuation certificate if the cocoa beans pass the quality examination test conducted by QCCL officials. Cocoa beans that fail the quality checks are subject to recondition. After reconditioning the DM can re-apply for evacuation certificate.

The DM calls the responsible OM for loading trucks for onward evacuation to the port once adequate quantity has been recorded in the district warehouse. The DM is required by COCOBOD to provide information about their LBCs as well as the source of the cocoa beans to be evacuated as a requirement for the granting of the evacuation certificate. This important requirement enables traceability of cocoa back to PCs. Just like the PCs, the DMs request for funds for their suppliers (the PCs) after submitting returns sheet for the previous purchases. For this purpose, the DMs have a notebook or general ledger where all their daily purchases or transactions are recorded. The DM's activities end after the dried bagged cocoa beans have been evacuated to the port and returns over the purchased cocoa beans has been submitted.

4.2.2.3. Business process of PMs. The business processes of the PM (shown in Fig. 6) is initiated by a trigger of a call from DM about departing trucks. The PM activities commence upon arrival of trucks from district depots and endorsed bush waybill from the truck driver is received. The PM then prepares port waybill and attaches the two waybills for submission to COCOBOD CMC officials. The results from the survey revealed that after submission of the two waybills to CMC officials, PM receives weighing bridge certificate from CMC officials. The PM also receives Cocoa Taken Over Receipts (CTORs), or summary sheet, from CMC officials. The PM has a general ledger or transaction database where CTORs vital information, information on weighing

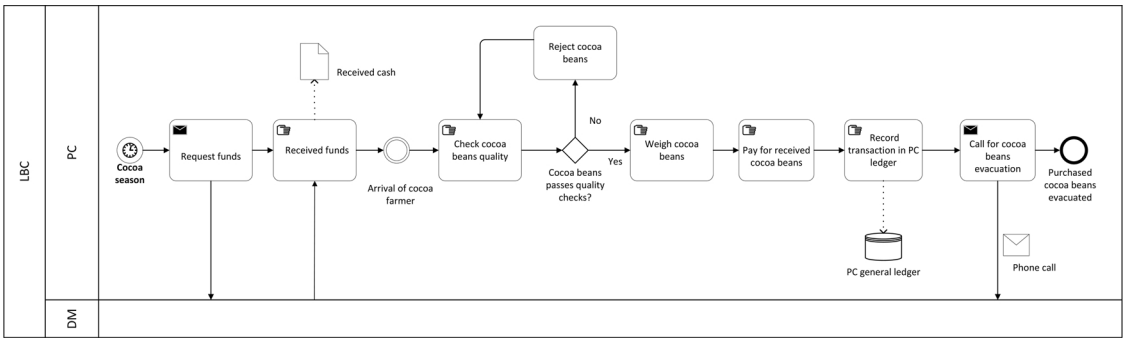

Fig. 4. Business process of purchasing dried cocoa beans.

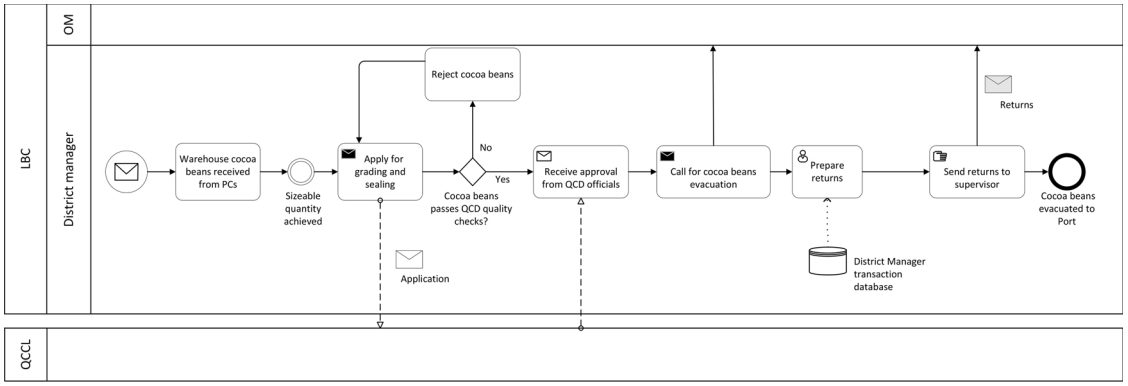

Fig. 5. Business process model of warehousing and evaluating of dried cocoa beans.

bridge certificate and daily transaction activities are recorded and stored. The PM activities end by sending copies of the CTORs to corresponding OM, which initiates the business process of the OMs.

This result highlights the crucial role of the PMs within the LBCs internal supply chain as well as the entire GCSC. The PMs serve as the final point of contact from which the cocoa beans are handed over to the CMC on behalf of COCOBOD. The PM is also responsible for the documentation of the delivery of the cocoa beans to the CMC officials at the port. The PMs have indepth knowledge about the operational activities of the LBCs as well as the port business activities of CMC, and with their central role, they could play a pivotal role in any effort that aims at redesigning the business processes of the GCSC.

4.3. Business process of OMs

The receiving of the CTORs from the PM starts the business process of the OMs (shown in Fig. 7). The business process is initiated after the OM receives CTORs and returns from PMs and DMs respectively. The returns prepared by the OM is attached to the CTORs and is sent to the CMC accounts department for claims. The activity "*send returns and CTORs to CMC accounts for claims*" is done manually. After the OM has submitted the returns and CTORs to CMC accounts department for claim processing, a decision is made whether or not the CTORs and returns will be approved. If the returns and CTORs are approved, the LBC receives money from COCOBOD; if they are rejected the LBC must review the returns for re-submission. The activity "*payment received from COCOBOD*" ends the business processes of the OM as well as the business process of the LBCs.

4.3.1. Business processes of COCOBOD

The two business processes of CMC are modelled into two lanes, as shown in Fig. 8, representing the process flow of the two business units: WPO and the shipping department. There was no sufficient information for modelling the business processes of CHED, CRIG and SPD, which are the other subsideries of COCOBOD.

4.3.1.1. Business process of WPO. The business processes of CMC are triggered when the officials of WPO takes over the driend and bagged cocoa from PMs of the LBCs, triggering the business process of WPO. Our results indicate that the officials schedule the trucks for offloading. The scheduling and offloading are recorded in the same database (shown as data store labelled *Cocoa information* in Fig. 8). After the trucks are offloaded, depot keepers of CMC prepare field reports, which in turn is used as input data in preparing CTORs. The CMC officials send the CTORs to the CMC statistics department. The statistics department sends the CTORs to the PMs of the LBCs. These two activities are done manually using paper froms and are therefore tagged as manual actitivites in the model. The business process of WPO comes to an end when the dried bagged cocoa beans are prepared for shipping and handed over to the CMC shipping department. This triggers the business process of the shipping department.

The manual and paper-based activities suggest that there is a lot of

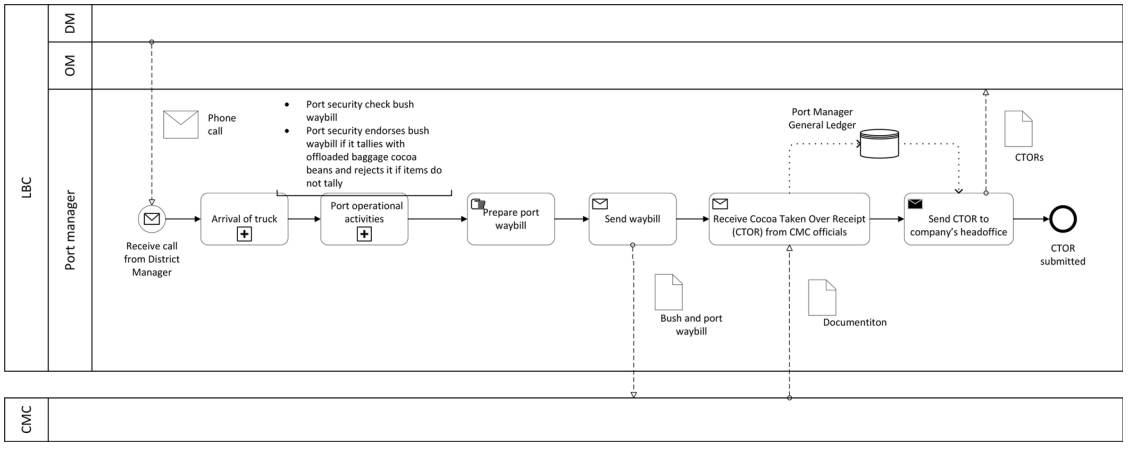

Fig. 6. Business process model of receiving cocoa beans from district depots and processing receipts.

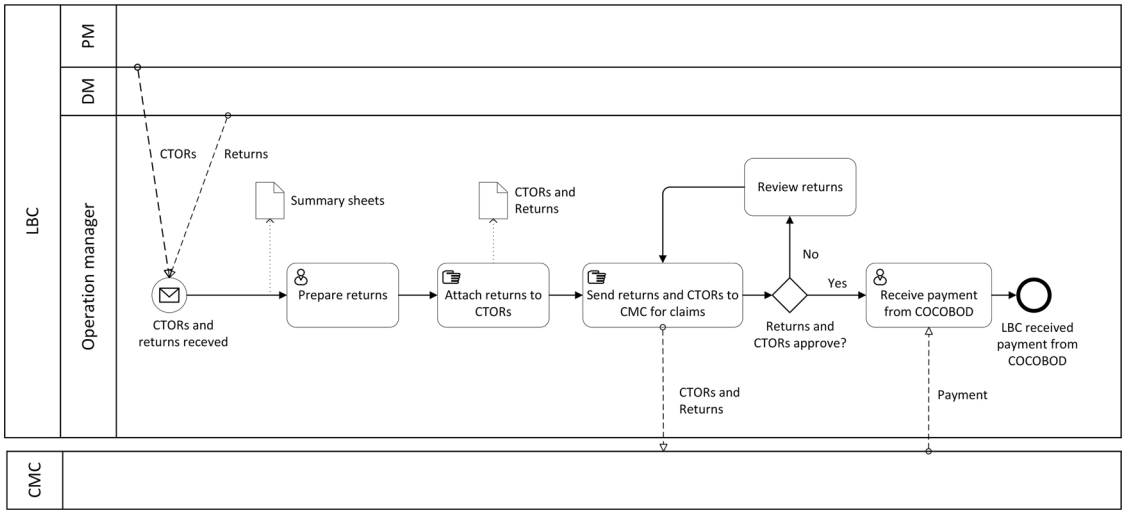

Fig. 7. Business model of receipts and returns submission.

manual handover in the CMC business process. For instance, the depot keepers need to manually prepare field reports after the offloading of the cocoa beans. The manual handover of paper forms increases the waiting time before the next activity can start. This clearly shows that the process flow can be enhanced by using IT systems for the scheduling of the offloading process and the preparation of the field reports. With the use of the right IT system, the schedules generated from the programming activity and the recodings of the offload activity could immediately have been used as inputs for generating the field reports.

4.3.1.2. Business process of the shipping department. The shipping department takes over the bagged cocoa beans (warehoused stocks) from WPO where the cocoa is stored. The shipping department ships cocoa to local and international customers. In the case of international shipping, the survey results reveal that CMC shipping department must seek advice from Bank of Ghana, Ghana Customs and Ghana Port and Harbor Authority (GPHA) before any shipping can take place.

The shipping department of CMC can only load containers when vessels are available. When no vessel is available the shipping department must wait for incoming vessels. The business process of the shipping department ends when the department ships the cocoa products to a destination abroad (see Fig. 8).

The results indicate that the shipping department liaises between the local and international buyers. These demonstrate that besides farmers, LBCs and COCOBOD, there are other supporting stakeholders such as the Bank of Ghana, GPHA and international buyers, which contribute to the execution of the business processes of LBCs and COCOBOD. The implication of this is that the views of these third-party stakeholders should also be incorporated when redesigning the business processes or drafting new and improved policies that affect the business processes.

The process descriptions highlight the dominance of paper-based systems across the board and the associated challenges already discussed. They also suggest that the inadequate use of technology is not only a drawback for LBCs, but also for COCOBOD, which is tasked to play a crucial role of improving the GCSC. The disciptions of the business processes indicate that the LBCs work in close coordination with COCOBOD, which suggests that their IT systems should also be integrated and well-aligned. If the integration and alignment could be achived, that will bring substantial efficeincy in the execution of the business processes of both the LBCs and COCOBOD.

4.4. Adoption of IT

This section presents the IT used by the actors in the GCSC to support their business processes. According to Piccoli's (2014) description

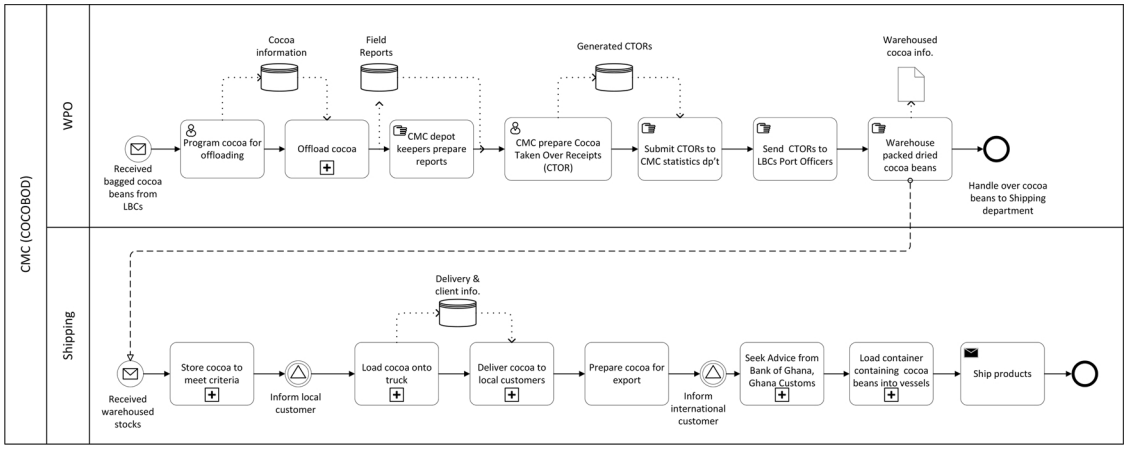

Fig. 8. Business process model of warehousing and shipping.

of information systems, the technical component refers to the software and hardware systems used. The manual activities used for information processing belong partially to the social sub-system (the actors and their relationships), and partially to technical component (for instance, the paper forms).

4.4.1. IT systems of cocoa farmers

Out of the 20 cocoa farmers sampled for the research, 16 (80 %) own mobile. Only one cocoa farmer owns a tablet. Out of the 16 farmers, half of them have access to internet in a form of mobile data on their phones. The survey results reveal that the use of IT systems by cocoa farmers is virtually non-existent. The faremrs' passbook could be digitized and the infromation made accessible to those farmers who have internet access. Those farmers could be trained on how to use their digital passbook, and this would in turn encourage the rest of the farmers to follow suit.

4.4.2. IT systems used by LBCs

The results show that 19 (95 %) of the PCs own and use mobile phone and 16 of them having access to internet in the form of mobile data. The use of paper-based forms by all PCs indicate that LBCs do not have appropriate IT systems for their PCs. On the other hand, LBCs use modern IT systems in their headquarters and port units, including: port information system, field information system, assets management system, general ledger accounts system, Human Resource (HR) management system, payroll processing system, and inventory management system. These systems are used by the PMs and OMs. LBCs also have websites which provide services to public users.

Though the LBCs deploy the aforementioned IT systems, it is obvious that the systems are underutilized. From the business processes of the LBCs presented in section 4.2.2, it is evident that paper-based forms are the primary means of manging and sharing informaiton. The PCs and DMs, for instance, have no access to these systems. As indicated for the case of the cocoa farmers, the PCs and DMs could also be trained on how to utilize their mobile technologies—technologies they already use in their personal lives—for recording and sharing information, and reduce errors in the collection of data and improving data accessibility.

4.4.3. IT systems used by COCOBOD

CMC used the following IT systems: inventory management system, accounting services system, LBC Management Information System (MIS), HR management system, marketing system, claim processing and procurement management services system. These systems are used by CMC to support both external and internal marketing of dried cocoa beans of the GCSC. Besides, CMC has a website that gives access to its public services. With such a commanding role in the GCSC, one may hold the view that IT systems will be widely used to support their business processes. As this study reveals, this is not the case. The systems listed above were not being used fully which may be the result of inadequate alignment between their business processes and the IT systems deployed.

4.5. Alignment of IT with the business processes

This section describes how the current business processes of the actors in the GCSC are supported by IT systems.

4.5.1. IT support for cocoa farmers business process

Farmers were asked to indicate the IT systems and hardware technologies used to support their current business processes in the cocoa supply chain. The results shown in Table 3 asserts the inadequate IT support and the use of poor hardware technologies detailed by Otchere et al. (2013); Antwi Opoku et al. (2015) and Ato Kumi (2016).

Table 3 shows the activities of the business process of the farmers, the corrsponding IT or any manual Information System (IS) they use to support the activities, and which IS hardware they used in relation to the activities. It turns out that farmers use thier mobile phones (hardware) to support some of the activities without any corresponding IT/IS support. This generally implies that they used their mobiles phones to make telephone calls in support of the activity. The results revealed that farmers call to seek support from farm labourers during land preparation and farm maintenance. The farmers also indicated that they call input dealers to seek advice on the types of fertilizer and pesticide to use during the farm maintenance. A significant number of empty cells in the table (shown as -) in Table 3 indicates that cocoa farmers perform their business processes with virtually no IT support. The only IS support available to cocoa farmers turns out to be the pass farmers passbook.

Table 3
IT systems used to support the business process of cocoa farmers.

Activities of cocoa farmers	IT/IS	Hardware
Site selection	–	–
Land preparation	–	Mobile phone
Lining and pegging	–	–
Shade establishment	–	–
Go for cocoa seedlings from COCOBOD SPU	–	–
Receive cocoa seedlings from COCOBOD SPU	–	–
Farm maintenance	–	Mobile phone
Harvest cocoa pods	–	–
Pod breaking operations	–	–
Ferment fresh cocoa beans	–	–
Sun drying of cocoa beans	–	–
Bagged dried cocoa beans	–	–
Send bagged beans to PC	–	–
Receive cash payment from PC	farmers' passbook	–

4.5.2. IT support for LBCs business processes

Table 4 shows that the LBCs deployed different IT/IS systems and hardware technologies such as field information system, port information system, desktop and laptop computers to support their business processes. The results however show that many of the activities are performed without any IT support. This observation also affirms the findings of Otchere et al. (2013); Antwi Opoku et al. (2015) and Ato Kumi (2016). Otchere et al. (2013) stated that the lack of IT support in the GCSC has reduced the sector's competitiveness and its inadequacy to generate expected level of revenues.

4.5.3. IT support for COCOBOD business processes

The COCOBOD CMC uses an ERP system that consists of warehouse and port management, marketing, procurement and accounting systems. CMC officials also deploy hardware technologies such as laptop and desktop computers to support their business processes. Paper-based forms are also used widely by CMC officials (see Table 5), as in the case of farmers and LBCs.

5. Conclusion

Numerous studies have been conducted in the Ghana cocoa industry by many researchers and international organizations. The focus of these studies ranges from the aspects of pest and disease control, cocoa certification, technical efficiency, sustainability, and marketing structures. To the best of our knowledge, none of these studies has dealt with the details the business processes and IT systems of the GCSC. The present research is, therefore, novel to studying business process management and information systems in the cocoa industry of Ghana.

The key actors in the GCSC are not only the cocoa farmers, LBCs and COCOBOD as widely reported in literature, but also the business units within these organisations, such as PCs, DMs, PMs and OMs within LBCs. The understading of the roles of these actors is crucial for understanding the business processes within the GCSC. Our findings

Table 4
IT systems used to support the business processes of the LBCs.

Activities of the LBCs	IT/IS	Hardware
Activities of PCs		
Request funds from DM	–	Mobile phone
Receive funds from DM	–	–
Check cocoa beans quality	–	–
Weigh cocoa beans	–	–
Pay for received cocoa beans	–	–
Record transaction in PC ledger	Paper based/ PC accounts ledger	Tablet
Call for evacuation of cocoa beans	–	Mobile phone
Activities of DMs		
Warehouse cocoa beans received from PC	–	–
Apply for grading and sealing	Paper forms	–
Receive approval from COCOBOD QCD	Paper forms	–
Call for cocoa beans evacuation to the port	–	Mobile phone
Prepare returns	Excel	Laptop/Desktop computer
Send returns to operations manager	Field Information System (FIS)	Laptop/Desktop computer
Activities of PMs		
Receive call from DM	–	Mobile phone
Prepare port waybill	Paper forms	–
Send waybills to COCOBOD CMC	–	–
Receive CTOR and weighing certificate	Paper forms	–
Send CTOR to manager	Paper forms/ Port Information System (PIS)	Laptop/Desktop computer
Activities of OMs		
Receive returns from district and PM	Paper forms/FIS/PIS	Laptop/Desktop computer
Prepare returns	Paper forms/ excel/ accounts system	Laptop/Desktop computer
Send returns and CTORs to COCOBOD CMC accounts	Paper forms	–
Receive payment from COCOBOD CMC accounts	–	–

Table 5
IT systems used to support the business processes of COCOBOD.

Activities of CMC (COCOBOC)	IT/IS Support	Hardware
Activities of WPO		
Program bagged cocoa beans for offloading	ERP/WaPM/ Excel	Laptop/Desktop
Prepare cocoa taken over receipts (CTORs)	ERP/WaPM/ Excel	Laptop/Desktop
Check cocoa beans quality	None	
Submit CTORs to CMC statistical department	ERP/WaPM	Laptop/Desktop
Send CTORs to LBCs PMs	Paper forms	–
Warehouse packed dried cocoa beans	–	–
Shipping de		
Activities of shipping department		
Store cocoa beans to meet criteria	–	–
Inform local customer	ERP/WaPM	Mobile phone
Load cocoa beans on trucks	–	–
Deliver cocoa to local customers	–	–
Prepare cocoa for export	–	–
Inform international customers	ERP/MS	Laptop/Desktop
Seek advice from Bank of Ghana an Ghana Customs	–	Mobile phone
Call Ghana Port and Harbour to check vessel availability	–	Mobile phone
Load cocoa loaded containers into vessels	–	–
Give shipping documents to shipping company	Paper forms	–
Abbreviations:		
ERP: Enterprise Resource Planning software		
WaPM: Warehouse and Port Management software		
MS: Marketing System		

indicate that there is a lot of handovers and waiting times in the business processes of the actors. The processes among the actors are not coordinated and properly aligned. Though some IT systems are deployed, paper-forms are more prevalent leading to inadequacies and inefficiencies, poor data management and unfair distribution of information among the actors. Our results indicate that despite the availbility of IT systems, the actual use of the systems in supporting the business processes is very low among all actors. Particularly the IT systems owned by LBCs are underutilized. This can be attributed to the lack of expertise or the proper configuration of the software applications.

In order to deploy the right sofwtare applications and use them appraopraitely to manage the business processes in supply chains, it is essential to model the business processes in first place (Verdouw et al., 2010). The business process models we provided will enhance common understanding between business process analysts, business owners and software engineers involved in the GCSC. These can help bring smooth translations from the current paper-based towards an IT-based management of the business processes of the GCSC. The models will help the proper exploitation of the IT systems already deployed at the LBCs and COCOBOD, and the development os an appropriate IT systems for supporting the farmers business process.

This paper could not focus on identifying and modelling the business process of international actors including buyers and also to cover a wider geographical space. These would have contributed vastly to the undertsanding of the interactions among domestic and international actors.

Future research should explore in detail the obstacles associated with each of the business processes of the actors. The outcome of such a research can constitute both the redesign the business processes and the implementation or configuration of IT systems so that the business processes and the IT are well-aligned.

6. Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Appendix A

Questionnaire.

Q. ID	Question	Response/ Possible answers
Q1.	Stakeholder/ Cocoa supply chain actor	
Q2.	What is the name of your organization?	
Q3.	What is your name?	
Q4.	What is your role in the organization?	
Q5.	What are your current supply chain activities (financial, material, information) based on your mentioned role?	
Q6.	Do you use any tool (ICT gadgets) such as desktop computers, tablets, mobile phones and paper-based systems to perform any of the above stated activities? For mobile phones indicate the brand and the type of internet (Wi-Fi/ Mobile data)?	1 = Yes 2 = No
Q7.	If **No,** why?	
Q8.	If **Yes** indicate the name of the specific activity, the tool, with whom do you use this tool, the information you ask and what you receive?	
Q9.	Have you witness any change in activities from the past 5 years compared to your current activities mentioned in Q5?	1 = Yes 2 = No
Q10.	If **Yes** indicate these new added activities?	
Q11.	What tool(s) (ICT gadgets) such as desktop computers, tablets, mobile phones and paper-based systems were you using in the past 5 years to perform your old activities?	
Q12.	Indicate for each tool the activity and the cocoa supply chain partner you interact with using the mentioned tool?	
Q13.	How many departments does your organization have?	
Q14.	Which department (s) manages your supply chain?	1. Logistics 2. Marketing 3. IT department 4. Other
Q15.	Does your organization have a business website?	1. Yes 2. No
Q16.	Who built this website?	1. In-house, 2. Outsourced, 3. Other
Q17.	Who maintains this website?	
Q18.	What is the uses or functions of this website? Indicate for each function the beneficiaries (function of the website to whom), the kind of information provided by the website and source of the information (information on the website was obtained from who).	
Q19.	What Information Systems (IS)/ software are currently in use by your organization? For each IS/ software indicate the uses, year of installed or built, who built it/them, who maintains it/them and what 'problem' obstruct their uses?	
Q20.	How do the existing IS/software stated in Q19 relate to each other?	

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.njas.2020.100323.

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