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ASSESSMENT OF THE BRAZILIAN CASH OPERATION THROUGH THE APPROACH OF SUSTAINABLE SUPPLY CHAINS

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ABSTRACT: The Brazilian cash logistics operation is sustained by one of the country's major supply chains and involves the flow of notes and coins between banks, various players of the economy and the population as a whole. Due to its dimension and geographic range, this chain produces a significant carbon footprint. The present study seeks to further explore the cash logistics operation using the sustainable supply chain approach, thus analyzing the chain framework and its management and suggesting improvements to be implemented as a means of reducing the equivalent carbon emission of this chain. As a final conclusion, it is observed that the use of environmental measures to monitor and assess the global impact of the cash supply chain management framework is still very limited.

***KEY WORDS**: supply chain management, sustainable chains, banking industry, carbon inventory.*

1. INTRODUCTION

Among the innumerous supply chains of the economy, the cash supply chain stands out for the complexity and uniqueness of its operation. Of national, and sometimes, international reach, the cash supply chain represents the set of processes, frameworks and components of the supply management of notes and coins in a certain country or economic block, executed with the participation of banks, financial institutions, advanced service points (terminals and ATMs), retail companies, etc. (Okino, 2010; Schautzer, 2007; Rajamani, Geismar, & Sriskandarajah, 2006). Its unique ability to encompass two-way flows characterizes a network structure based on the behavior of its members.

The Brazilian cash supply chain includes the Central Bank, values transporters, banks, financial institutions and retail companies, all of which participate in transactions of banknotes in the national economy. The quantities and values of banknotes are substantial and despite the increased use of "virtual money", the volume of notes and coins in circulation continues to rise, as is shown by the 88,7% increase in cash circulation between 2007 and 2010, from R$80 billion (Banco Central do Brasil *apud* Federação Brasileira de Bancos [FEBRABAN], 2008) to R$151 billion (Banco Central do Brasil, 2011), respectively. This trend is similar to that of North America, which reached a cash circulation volume of US$ 955 billion in 2010, compared to US$ 690 billion in 2006 and US$ 492 billion in 2001 (Rajamani, Geismar, Sriskandarajah, 2006). In the European Community (Eurosystem), the circulation volume reached €840 billion in 2010 (European Central Bank, 2011), compared to €628 billion in 2007 (Schautzer, 2007).

Despite the complexity of the chain and the relevance of the subject matter, cash supply chain management practices have not yet incorporated the course of action and outcomes that often result from academic research. Rajamani, Geismar and Sriskandarajah (2006), in their bibliographic research, did not find studies or practical applications of the concepts of supply chain management in the problem of cash transfers; the findings of their research are similar to those of the authors of the present article. Seemingly, the only information and publications available are those

found in the reports published by central banks, government organizations, consulting firms and private banks, and may not always incorporate academic rigor in their elaboration. Moreover, there is hardly any academic assessment of the impact of the logistical operation on Greenhouse Gas (GHG) emissions or other processes that may harm the environment.

In this context, the present article, using reference models, describes and analyzes the Brazilian cash supply chain from the viewpoint of "sustainable supply chains," generating insights and suggestions to improve the management of the chain with respect to the reduction of adverse effects in the environment.

Initially, a brief description of the cash supply chain is given using Cooper, Lambert e Pagh's Supply Chain Management framework (1997) and the Supply Chain Operations Reference Model (SCOR), version 10.0, of the Supply Chain Council [SCC] (2010). The first framework allows for an assessment of the chain from a strategic and structural point of view while the second enables a greater operational and functional detailing of the chain.

This initial description prompted an analysis of the cash supply chain using the sustainable chain approach. For this analysis, the SCC model GreenSCOR (2010) and other complementary concepts, such as the Carbon Inventory and the GHG Protocol[1], were used.

Due to the characteristics of the collected data and the unchartered aspects of the object of study – cash supply chain operation and its environmental impact – the present study is of an exploratory nature.

2. LITERATURE REVIEW

2.1 Cash Logistics and the Brazilian Operation

The management of the Brazilian cash supply chain is a logistical operation carried out by, and depending on, a wide network of points of supply comprised by the Branches, the Customer Site Branches (CSBs), the Automated Teller Machines (ATMs), the Financial Institutions (many of which associated to the Commercial Banks) the Bank Correspondents (companies that render banking services through associations with the Banks) and the Major Retailers, which receive and supply large volumes of cash to the population. The well-functioning of this operation depends on providing these points of direct contact with support from an extensive network of suppliers, particularly transporters of cash and custodians (in Brazil, the official custodian appointed by the Central Bank is currently the government-owned Banco do Brasil) (Okino, 2010).

According to data from the Brazilian Central Bank (Banco Central do Brasil, 2010a), in April of 2010, the total amount of banknotes in circulation in the country was approximately R$120 billion. Of this total, which represents 53% of the payment methods used by the Brazilian population, R$97 billion (81%) is under public possession and R$23 billion (19%) in bank holdings, serving as a service level guarantee.

When compared to those of other countries, this amount is still low, as is seen in Table 1.

Table 1 – Currency in circulation as a % of GDP

Year	Brazil	England	Europe	Japan	USA	Mexico
2002	2.8%	4.0%	5.5%	15.3%	6.3%	3.9%
2003	3.2%	4.2%	6.5%	16.1%	6.3%	4.2%
2004	3.5%	4.0%	7.1%	15.9%	6.2%	4.5%
2005	3.4%	3.6%	6.7%	14.3%	6.1%	4.7%
2006	3.8%	4.0%	7.9%	14.8%	5.9%	5.0%

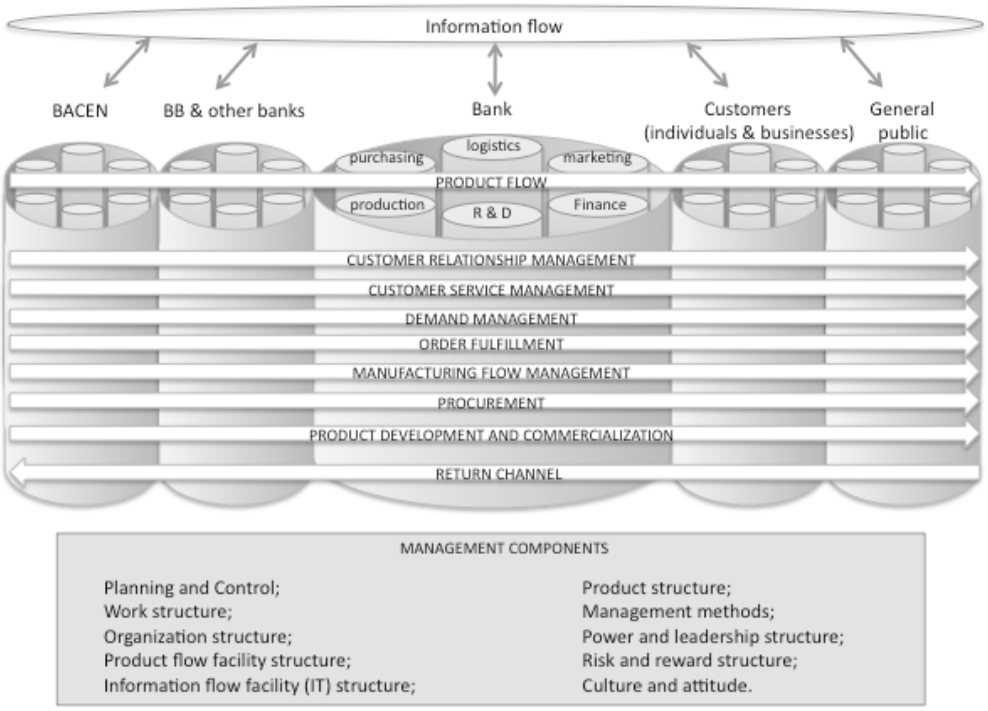
Source: Central Banks and World Bank apud FEBRABAN (2008).

Note: adapted by the authors.

Data on the evolution of the use of cash in Brazil demonstrate an exponential increase in cash use since the country's economic stabilization in the 1990s, potentially indicating a trend that nears the *Cash Circulation x GDP* index of developed countries.

Figure 1 schematically presents the cash supply chain framework, business processes and management components based on the Cooper, Lambert and Pagh model (1997).

Figure 1 – Lambert's SCM model applied to the Brazilian cash supply chain.

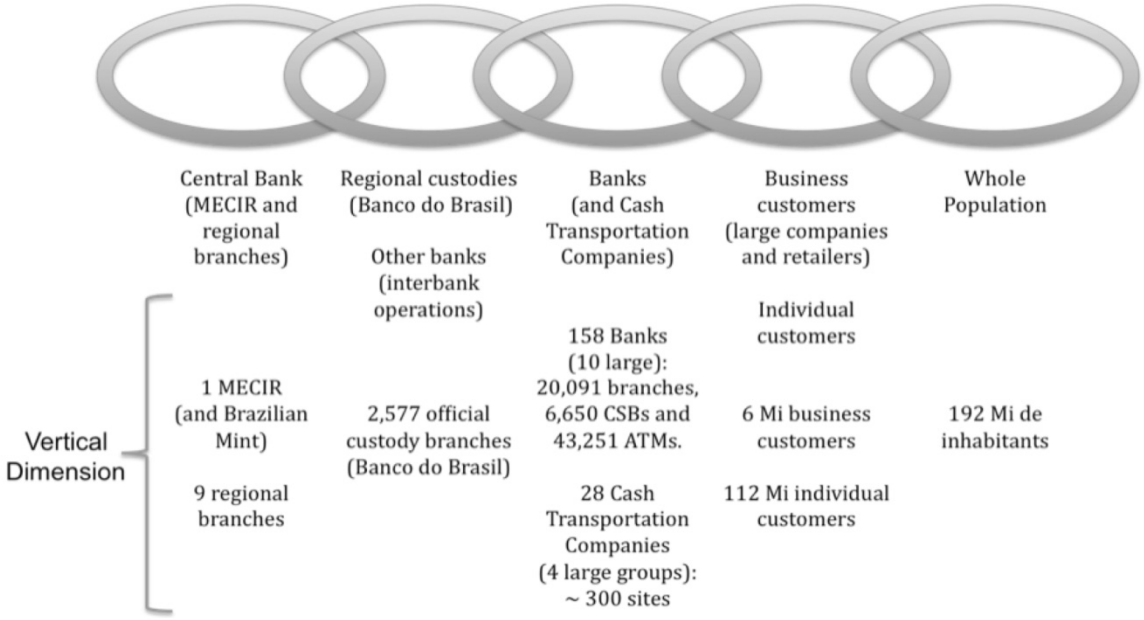


Source: prepared by the authors using Cooper, Lambert and Pagh (1997).

The cash logistics operation presents a complexity to the chain structure due to the two-way flow of the product: the cash flows from the Central Bank to the clients as well as from the clients to the Central Bank. The two-way flow in all links of the chain presents a complexity that exceeds what has been considered in the Reverse Logistics model. Furthermore, the extend of the chain, as well as the peer-to-peer relationship of the participants, create a plurality of interfaces between members, characterized as a network operation, as proposed by Halldorsson (2007).

The data brought forth by Okino (2010) indicate that, despite the distinctiveness of the source of the raw material of the cash operation chain (Brazilian Mint, through the Department of Money Supply of the Brazilian Central Bank), the number of participants in the chain increases at each link and reaches the entire Brazilian population (192 million people) in the chain's final node, thus assuring the great amplitude of its vertical dimension.

Figure 2 – Vertical dimension of the cash supply chain.



Source: Okino (2010).

Okino (2010) also mentions as peculiarities of this chain:

1. The flow of materials does not occur solely in one direction, as there is a supply of cash sent to the market (clients and society) as well as a return and redistribution of the cash through the network. This framework is similar to that of reverse logistics and can be characterized as a closed-loop supply chain. (Rajamani, Geismar, & Sriskandarajah, 2006).

2. The high value of stored and transported materials, which deems relevant financial aspects (interest on invested capital) as well as other related to the security of the operation (thefts and robberies).

3. The demand for a high service level, since the image of solidity and reliability of the entire system or of one of its institutions can be adversely affected if delivery points do not have cash.

4. The fact that cash transportation operations are, in general, outsourced to value transportation companies specialized in their logistics but are managed and coordinated directly by banks. As such, the link of the chain that regards transportation is not properly independent from the others (banks).

2.2 Sustainable Management of the Supply Chain (Green Supply Chain Management)

The final consumer is increasingly concerned with the environment and demanding of ecologically correct positioning from companies and the concept of Green Supply Chain Management offers a wide range of studies and research possibilities (Chakraborty, 2010)In a research study conducted using 1,500 articles, book chapters, publications and journal articles, of which 227 were selected as having specific content referring to Green Supply Chain Management (GrSCM), Srivastava (2007) concludes that the increased importance attributed to environmental factors originate from rising levels of environmental deterioration, decreasing availability of natural resources, overloading of the areas utilized for the disposal of effluents and increasing levels of pollution.

This new behavior, when combined with social concerns, turns the adoption of environmental policies by companies an ever-increasing necessity. Government regulations and societal demands regarding the environmental accountability of companies' operations have inserted this matter into executive agendas and strategic planning discussions, even considering the differences in demands and environmental awareness of consumers according to

the country and social segment in which they live (Chakraborty, 2010). Along with integrating operations in their supply chains in order reduce costs and improve customer service, companies are also seeking to meet environmental demands imposed by society (Sen, 2009). As such, the management of operational processes in the supply chain aimed at improving performance and environmental concerns should be approached as complementary interests. In some cases, the integration of suppliers and clients in company decisions may allow a company to meet or even exceed the environmental commitment expectations of its final consumers and the government (Walton, Handfield, & Melnyk, 1998).

The research conducted by Thun and Müller (2010) on the German automotive industry demonstrates that the concept of green management in the supply chain is still incipient. While the application of management practices in the supply chain can be traced back to the beginning of the 1980s, green practices are more recent, with most companies implementing these practices in the last five years (in 2004, relative to the year of the publication of the study). This conclusion is similar in the academic community, as is demonstrated in the Carter and Easton (2011) study in which 80 articles chosen from a selection of 132 identified articles published in relevant journals between the years 1991 and 2010 were analyzed. This study showed that approximately 55% of the analyzed articles failed to apply any theoretical knowledge regarding sustainability in the analysis and the proposal of supply chain management. Another distinct characteristic could be seen when the time period was divided into two (1991 to 2000 and 2001 to 2010): while in the first period, the percentage of articles without any theoretical foundation was 87.5%, in the subsequent period this percentage was reduced to 33.3%, demonstrating an evolution in the manner through which the subject was considered by the academic as well as the business community.

As stated by Srivastava (2007), the notion of social responsibility centered on the project of products, processes, marketing, operations and effluent management of a company or on a single link of the generally extensive supply chain has changed: since 1990, the concern has been more comprehensive, taking into consideration all links of the chain and final impacts on the environment. Alternatively, as the greening of the supply chain is a diverse and complex issue, covering aspects such as environmental degradation, rising prices for energy and natural resources, unfair wages, consumers' expectations, etc, the incurred costs are not always reflected in the price of finished products, but are instead externalized to the public (Larson, 2009).

According to Hervani e Helms (2005), in their work with GrSCM, the sustainability improvements in the supply chain begin with an understanding of current sustainability conditions, followed by analysis, measurement of environmental impact by indicators and continuous improvements guided by ISO-14000 standards, thus constituting the steps "planning, execution, verification and performance".

The GrSCM model is based on the framework of conventional supply chain management processes (Thun,& Müller, 2010); so, it is not possible to separate these two ways of management. In fact, in examining the SCOR 10.0 analysis framework proposed by the Supply Chain Council (SCC, 2010), one observes that the difference between the two concepts lies in the introduction of several processes (notably, the capture and disposal of effluents), additional adopted metrics (basically referent to gas emissions and ecological footprint) and recommended best practices (collaboration throughout the entire chain, minimization of consumption and use of energy and fuels and minimization of the use and re-use of packaging).

Noteworthy results of the Thun and Müller (2010) study include:

a. Although of great relevance to green management supply chain practices, measures such as "efficiency in the use of resources", "cost reductions" and "exploitation of the competitive advantage resulting from green practices" are rarely used by companies.

b. Competition and clients are the main motivators of the application of green concepts in management.

c. Companies recognize that, in order to meet and improve sustainability objectives, efforts must be coordinated and incorporated by all nodes in the chain. As such, the formulation of environmental policies that are aligned with ecologically oriented concepts and objectives is necessary, reflecting the concern of keeping the operation environmentally correct from "cradle to cradle"

d. Green management practices are recent, not well understood and considered as "ambitious targets". Initiatives still occur almost solely within a

company and do not seek to involve other players in the chain. Nevertheless, there is a tendency for these practices to become increasingly important for industries and companies in general.

It is possible to conclude that GrSCM practices are recent, having received more attention from the business and academic communities in the last 5 to 10 years. Moreover, it becomes apparent that the mindset of managers is still concentrated on one link (the company) instead of on the entire chain, that encompasses recovering, recycling, remanufacturing, refurbishing and landfill/incinerator management ("cradle to cradle" – Larson, 2009; Zhu and Sarkis, 2007). And lastly, after a more simplistic approach barely anchored in concepts and theories of administration, in which sustainability was interwoven with the preservation of the environment, one observes a tendency of more profundity and coverage in research studies, in the treatment of problems and in practices of sustainable management trough the entire supply chain (Carter, & Easton, 2011). Of course this broader approach requires performance measurement systems within and between all the nodes through the entire chain and not only for one of its links. (Hervani, Helms and Sarkis, 2005.

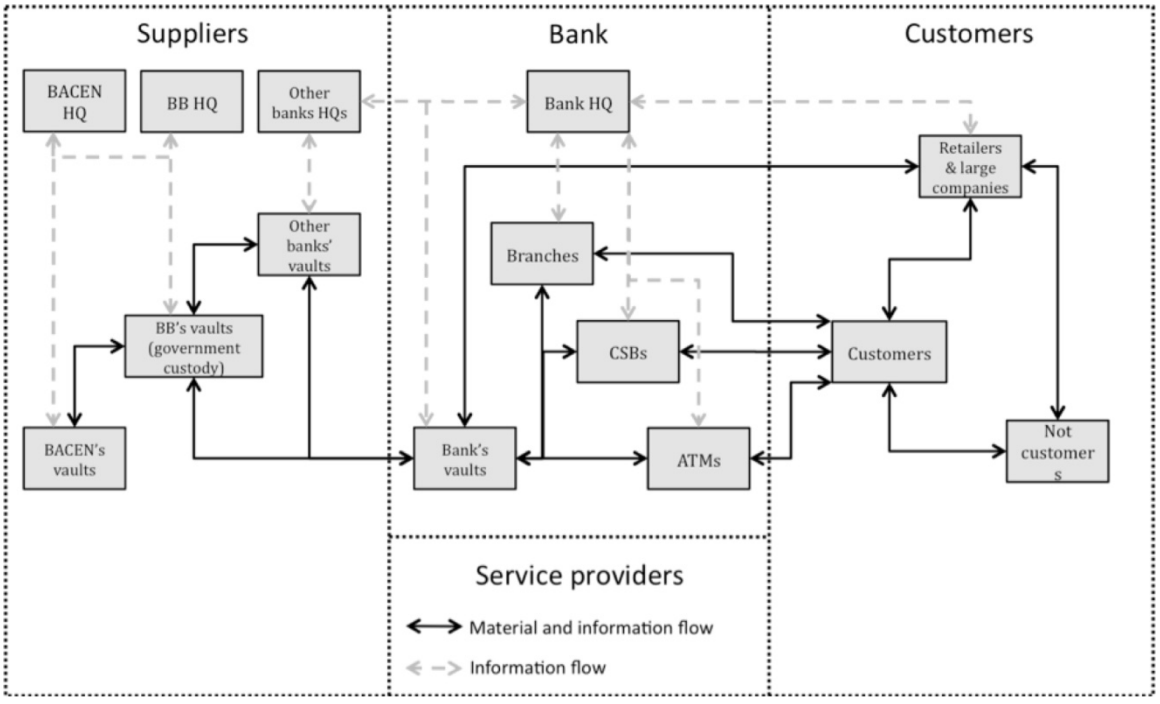
2.3 Reference Models for the Analysis of the Supply Chain Management

The cash logistics operation, despite its particularities, can be characterized as a supply chain. Although there are various ways to measure the environmental footprint of an organization or its supply chain, no standard format has yet been defined.

One well-accepted model is the Supply Chain Operations Reference model [SCOR] (SCC, 2010). SCOR is one of the few models that permit administrators to simplify the complexities of supply chain management and facilitate strategic decision-making (Huan, Sheonran, & Wang, 2004). It joins the view of business processes with metrics, market best practices and use of information technology in a unique structure that enables communication between the various players of a supply chain. As a result, SCOR is able to increase the effectiveness of chain management as well as that of other related activities (SCC, 2010).

Okino (2010) attained the Business Scope Diagram of the Brazilian cash supply chain (level 1) using the SCOR model, as presented in Figure 3.

Figure 3: SCOR – Level 1 – Business scope diagram of the Brazilian cash supply chain.



Source: Okino (2010)

Since 2008 (version 8.0), SCOR incorporates as part of GreenSCOR processes, metrics and best practices geared toward sustainable management. These metrics are presented in Table 2.

Table 2 – Strategic environment metrics of the GreenSCOR framework.

Metric	Unit	Basis
Carbon Emissions	Tons CO_2 Equivalent	This is the unit of measure currently used for green house gas emissions and is a measure of the climate impact from CO_2 and other global warming air emissions.
Air Pollutant Emissions	Tons or kg	This would include emissions of major air pollutants (COx, NOx, SOx, Volatile Organic Compounds (VOC) and Particulate). These are the major emissions that U.S. EPA tracks.
Liquid Waste Generated	Tons or kg	This includes liquid waste that is either disposed of or released to open water or sewer systems (these emissions are generally listed on water emissions permits).
Solid Waste Generated	Tons or kg	The total solid waste generated by the process.
% Recycled waste	Per cent	The per cent of the solid waste that is recycled.

Source: SCC (2010)

The Greenhouse Gas Protocol currently contains the most widely-used standards, criteria and procedures for quantifying carbon emissions and atmospheric pollutants at each node of the chain, organization or corporation.

The methodology of the GHG Protocol permits the identification, calculation and elaboration of a GHG emissions inventory in the organizational level and is compatible with ISO standards and the Intergovernmental Panel on Climate Change (IPCC) quantification methodologies (application in Brazil is adapted to the national context). Moreover, the information generated by this methodology can be applied to the questionnaires and reports of other initiatives such as the Carbon Disclosure Project, Bovespa Business Sustainability Index [ISE] and Global Reporting Initiative [GRI] (FGV & WRI, 2010).

3. RESEARCH METHODOLOGY

In order to achieve its objective, the present study was organized into four fundamental stages:

a. Characterization of the cash logistics chain: provide an overview of the cash operation, describing the scope, key players, volumes and products involved.

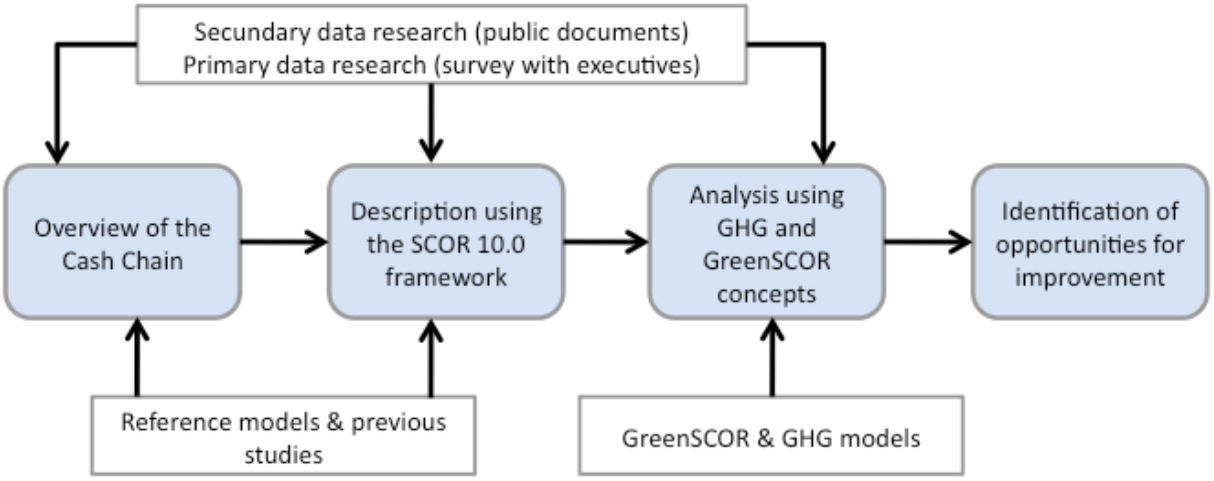
b. Description, according to the SCOR 10.0 framework: give a description of the supply chain, its flows, processes and relationships according to the SCOR 10.0 standards.

c. Analysis according to GHG and GreenSCOR concepts: identify the typical sustainably supply chain management processes (GreenSCOR), define evaluation metrics (index) with tabulation and analysis of the observed values.

d. Identification of Improvement Opportunities: propose improvements for the sustainable cash supply chain management in Brazil, based on best practices as depicted by GreenSCOR and gathered data.

Figure 4 illustrates its sequence and interrelationships.

Figure 4 – Research phases and their interrelationships



Source: the authors.

A primary and a secondary data research was conducted to detail the Brazilian cash operation as Supply Chain Management and to understand the sustainability aspects related to this operation.

For the cash operation analysis, the data research was structured using the Cooper, Lambert and Pagh (1997) SCM model with its framework of three dimensions (Supply Chain Structure, Business Processes, Management Components) and twenty-one sub-components. For each dimension and each subcomponent was identified the more suitable source of data research, i.e. primary or secondary, as shown in the Table 3.

Table 3 – Research type for each SCM model dimension.

Dimension	Characteristic or Component	Type of Research
1 – Supply Chain Structure	1.1 – Members identification	Primary and Secondary
	1.2 – Dimensions	Primary and Secondary
2 – Business Processes	1.3 – Process links	Primary
	2.1 – Customer relationship management	Primary and Secondary
	2.2 – Customer service management	Primary
	2.3 – Demand management	Primary
	2.4 – Order fulfillment	Primary
	2.5 – Manufacturing flow management	Secondary
	2.6 – Procurement	Primary
	2.7 – Product development and commercialization	Primary
	2.8 – Returns	Secondary
3 – Management Components	3.1 – Planning and Control	Primary
	3.2 – Work structure	Primary
	3.3 – Organization structure	Primary
	3.4 – Product flow facility structure	Primary
	3.5 – Information flow facility (IT) structure	Primary and Secondary

	3.6 – Product structure	Primary
	3.7 – Management methods	Primary
	3.8 – Power and leadership structure	Secondary
	3.9 – Risk and reward structure	Primary
	3.10 – Culture and attitude	Primary

Source: prepared by the authors using the Cooper, Lambert & Pagh's SCM model (1997) as reference.

The primary data for the cash logistics operation was collected from questionnaires applied to members of various nodes of the supply chain. The questionnaire was developed align with the dimension and components of the Cooper et al. (1997) SCM model as presented in the previous table. Two hundred sixty-eight answers were provided by thirteen executives of the companies involved in the operation, including commercial banks, the Brazilian Central Bank, transporters, retailers (large clients and legal entities) and custodians (Banco do Brasil), as displayed below.

Table 4 – Companies that participated in the survey of the cash supply chain.

Type of Player	Company name	Company's full legal name
Regulatory and government custodian	BACEN	Brazilian Central Bank
	Government custodian	Banco do Brasil S.A.
Banks	Itau	Itau Unibanco S.A. (1)
	Unibanco	Itau Unibanco S.A. (1)
	CEF	Caixa Economica Federal
	Bank 4	Bank 4 (confidential)
Cash transporters	Protegé	Protege S.A. Prot. e Transp. de Valores
	Rodoban	Rodoban Seg. e Transp. de Valores Ltda.
	Transvip	Transvip Trans. de Val. e Vig. Patr. Ltda.
	Transporter 4	Transporter 4 (confidential)
	Transporter 5	Transporter 5 (confidential)
Customers	Ultragas	Companhia Ultragaz S.A.
	Customer 2	Customer 2 (confidential)

Note: Despite the Itau-Unibanco merger announced in November 2008, these banks were considered separately in this study.

Secondary data for the cash logistics operation was collected through research with the entities involved in the operation, including the Brazilian Central Bank (BACEN), the National Federation of Banks (FEBRABAN) and the Brazilian Association of Cash Transporters (ABTV).

For the identification of the sustainability aspect related to this operation, a secondary data research was conduct through bank annual reports and sustainability reports. The public documents analyzed with regards to the sustainability of banks are presented in Table 5. The research was derived from the GreenSCOR metrics of the SCOR of SCC (2010) framework and took into consideration the most important environmental aspects of the cash logistics operation. For the purposes of this study, the Carbon Emissions metric was chosen among the environmental strategy management measures indicated on the GreenSCOR. Other metrics of the GreenSCOR ("Emission of Atmospheric Pollutants (others)", "Generation of Liquid Waste", "Generation of Solid Waste", "% of Waste Recycled) were of little relevance in the cash logistics operation and, as such, were not used for the collection of data.

Table 5 – Bank's documentation on sustainability analyzed.

Bank	Documents
Banco do Brasil	• Greenhouse gas inventory report – 2008 (BANCO DO BRASIL, 2009) • Annual report - 2009 (BANCO DO BRASIL, 2010a) • Greenhouse gas inventory report – 2009 (BANCO DO BRASIL, 2010b)
Bradesco	• Greenhouse gas inventory report – 2009 (BRADESCO, 2010a) • Greenhouse gas inventory corporate report - 2009 (BRADESCO, 2010b) • Sustainability report - 2009 (BRADESCO, 2010c)
Itaú Unibanco	• Sustainability report - 2008 (ITAÚ UNIBANCO, 2009) • Greenhouse gas inventory report – 2009 (ITAÚ UNIBANCO, 2010a) • Sustainability report - 2009 (ITAÚ UNIBANCO,2010b)
Santander Real	• Greenhouse gas inventory report –2008 (BANCO REAL, 2009) • Greenhouse gas inventory report – 2009 (SANTANDER BRASIL, 2010a) • Annual report - 2009 (SANTANDER BRASIL, 2010b)

Source: secondary research performed by the authors.

The limited amount of data on the environmental impact of activities related to the transportation of cash in Brazil enhanced the challenge of creating a more accurate mapping of this aspect of cash supply chain management. When quantitative data was not available, the chain framework and the involvement of the players were analyzed using a phenomenological approach in compliance with the criteria of exploratory research.

4. ANALYSIS OF RESULTS AND DISCUSSION

The chain framework presented in Figure 2 was used to analyze the sustainability aspects of the cash supply chain, for which the Central Bank was considered the focal point of the chain. The analysis was conducted in three phases: supply links (operations and players of the chain found prior to the supply of cash for the Bank Treasury), delivery links to clients (operations and players after the Bank Treasury) and chain framework (analysis of the functions of participants and the interrelations of the cash supply chain).

4.1 Analysis of sustainability in supply links

The findings of the data collected from the primary and secondary research show that the initial nodes of the supply chain are comprised of the primary supply of the Brazilian Mint and distributed by the Central Bank (BACEN) through the Department of Money Supply of Rio de Janeiro (MECIR) and its nine regional stations (refer to Figure 2).

The next node in the chain is composed of Banco do Brasil branches that are authorized to render the services of official custodian of the money supply. There are 2,577 units of Banco do Brasil that operate as custodians, providing services, as depositaries, to other regional banks (Banco Central do Brasil, 2010b). Banks do not transact directly with the Central Bank as all transactions are made through an official custodian (Banco do Brasil).

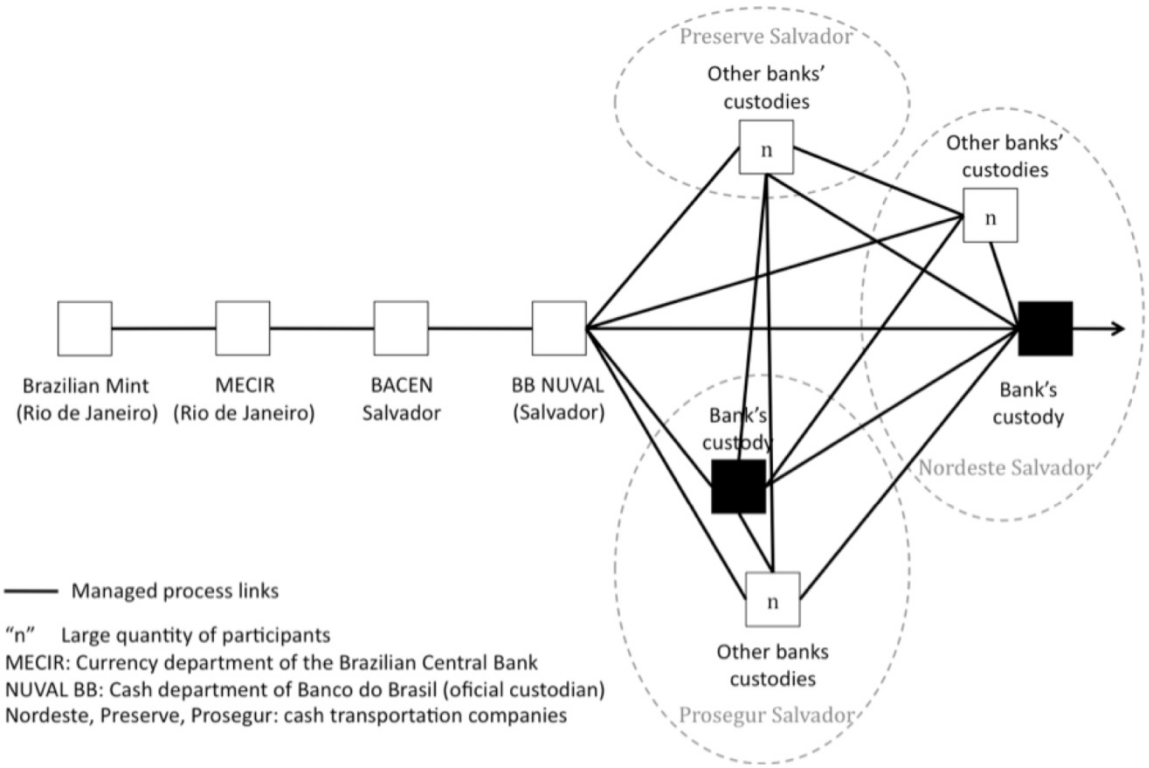
The following node is composed of bank treasuries, which physically operate in the custodies of transporters. The conducted research shows that there are approximately 300 value transportation bases in Brazil, each with the custodies of various banks.

The analysis of this chain configuration demonstrates inefficiencies in transportation between the BACEN and the custodies of Banco do Brasil (official custodian). These inefficiencies generate carbon equivalent emissions that could be reduced if more effective measures were adopted.

The complex network of transportation between the links of the supply chain became evident in the qualitative research, which showed large quantities of cash transported between the official custodian (Banco do Brasil) and the custodies of banks in the transporters. Figure 5 illustrates an example of the service provided in the Salvador region, where the main banks operate with three transporters (Prosegur, Preserve e Nordeste), thus generating a complex inbound cash supply chain.

The analysis of the Salvador service displays another inefficiency of the chain in the supply link: the high number of bank custodies and their relationships with other custodies and with the Banco do Brasil custody generate a potentially inefficient transportation network. The optimization of this part of the supply chain would reduce costs and corresponding carbon equivalent emissions generated in the transportation of cash between Banco do Brasil and other banks.

Figure 5 – Simplified chart of the Salvador cash supply chain.



Source: devised by the authors using the Cooper, Lambert and Pagh (1997) model.

4.2. Analysis of sustainability in the delivery links to clients

The analysis of the sustainability aspects of the operation to deliver cash to clients was realized primarily using information obtained in secondary research in the annual and sustainability reports of banks, as stated in the methodology of this research. The operations of four banks (Banco do Brasil, Bradesco, Itaú Unibanco e Santander Real) were analyzed using publicly available information on GHG emissions relative to the national operations during the time this research was conducted.

Table 6 provides a summary of the tCO^2-e emissions (tons of equivalent CO^2) of the banks in the year 2009.

Table 6: tCO_2-e emissions (CO_2 equivalent tons) – year 2009

Scope	Fontes típicas	Itaú Unibanco	Bradesco	Santander	Banco do Brasil
1	Combustion in owned or controlled boilers, furnaces and vehicles, etc	4.923	5.084	1.106	ND
2	Consumption of purchased electricity	14.223	10.253	6.855	ND
3	Employee, material, cash and document transportation	71.355	144.304	25.870	ND

Source: reports issued by the banks: Itaú Unibanco (2010a,b), Bradesco (2010a, b, c), Santander Brasil (2010a, b), Banco do Brasil (2010 a, b).

Note: organized by the authors.

The data presented in Table 6 indicate that the Transportation of Values, within scope 3 emissions (transportation in general), is the most CO_2 equivalent emitting activity of the cash logistics operation, representing relevant percentage of all values of indirect emissions for all banks.

4.3 Sustainability analysis of the chain framework

The local initiatives of chain participants in reducing the carbon footprint of the cash logistic operation have an important environmental impact, although they do not necessarily optimize the supply chain as a whole. As previously mentioned, there are inefficiencies in the transportation of cash in several links of the supply chain. The existence of various official custodian branches and the existence of bank custodies in different places within the same region generate unnecessary cash transport that could be eliminated in an optimized supply chain structure.

Hervani and Helms (2005) indicate that one of the difficulties in measuring the environmental impact of supply chains is the local, individual focus of the various methodologies available, which often analyze the impact of the operations of only one player in the chain. According to these authors, Green Supply Chain Management should target the distribution of responsibility for social impact among all of the participants in the chain as a means of achieving impact reductions objectives defined by the sector.

4.4 Opportunities for Improvement

The first improvement opportunity lies on the implementation of measures to calculate the environmental impacts of the cash logistics operation by the banks and in the standardization and improvement of the GHG emissions inventories related to this operation. The involvement of other participants in order to map the emissions of the entire supply chain is also important. The framework GreenSCOR of the SCC, which offers metrics for the management of the environmental strategy of the supply chain (SCC, 2010), can be used as a reference for the adoption of environmental indicators in the cash logistics operation. For the elaboration of the inventories, the proposed methodology is the Brazilian Program GHG Protocol (FGV & WRI, 2010).

Further opportunities lie in the adequacy of the chain framework so as to optimize transportation and reduce the carbon footprint of the chain. This capability may be achieved through the adoption of a privatized custody and processing system, as has been done in the United States. In the United States, the chain configuration endorsed by the Federal Reserve selects a private institution to assume the role of official custodian (Rajamani, Geismar, Sriskandarajah, 2006). This permits banks to share the same custodian, often located in transporters, and avoids competing structures and unnecessary transportation between various custodians found in the same region (Blacketer, Evetts, 2004).

Figure 6 – Superposition of ATMs networks in a same place.

Source: "Imesá Construções", site <http://www.lmesa.com.br/obras_hotel.htm>.

Another opportunity for carbon equivalent reductions lies in the sharing, by banks, of the nationally-available customer service framework. The existence of proprietary networks of ATMs by Brazilian banks generates inefficient customer service to the end client. While major banks maintain their own networks of ATMs to better serve their clients (competitive advantage), the refusal to share ATM networks as is done in other countries creates an overlap of networks and a waste of resources and assets, as is suggested by Matutes and Padilla (1994). Figure 6 illustrates the situation of shared space by different brands in large centers in Brazil.

5. CONCLUSIONS

Due to the size of the cash logistics operation, the amount of transport operations is large. As such, the cash transportation operation, made up of internal combustion vehicles usually powered by diesel, emits large quantities of CO_2 equivalent. As identified in the analysis of the aspects of the Green Supply Chain for this operation, the transportation of cash is one of the main sources of indirect greenhouse gas emissions (scope 3).

The use of Green Supply Chain concepts, though limited by the restricted availability of data on the environmental impact of the cash logistics operation in Brazil, allowed for an initial analysis of this important aspect of supply chain management. It is evident that there are a few bank concerned with the environmental impacts of their operations and that some are already using widely-accepted metrics and methodologies (GHG Protocol methodology) to calculate the environmental impact of their cash logistics operations. However, the use of environmental measures to monitor and assess the global impact of the cash supply chain management framework is still very limited.

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(Endnotes)

1 END NOTE

The Greenhouse Gas Protocol, also known as GHG Protocol, was developed internationally by the World Resources Institute (WRI) in partnership with the World Business Council for Sustainable Development (WBSCD). The national development of the Brazilian Program GHG Protocol is coordinated by the Research Center in Sustainability Studies of EAESP in the Getulio Vargas Foundation jointly with the WRI and in partnership with Ministry of Environment, the Brazilian Business Council for the Sustainable Development and the World Business Council for Sustainable Development (WBCSD) (FGV & WRI, 2010).

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