

# Modelling African Supply Chains from the Seaport to the Hinterland

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## Abstract

Supply Chains in Sub-Saharan Africa work differently from the ones in industrialized countries. Specific processes and circumstances have to be considered for supply chain management and humanitarian operations. The paper aims to make African supply chains visible. It focuses on Cameroons seaport in Douala and models the processes with BPMN to the Hinterland.

**Keywords:** African humanitarian supply chains, process modelling with BPMN, seaport

## Introduction

For many countries in Sub-Saharan Africa can be stated that droughts and hunger occur regularly and that life expectancy is comparatively low. Many challenges have to be addressed to overcome the existing situation, e. g. the supply with food and medicines must be enhanced. When addressing these challenges special circumstances in African countries such as the infrastructural conditions, educational level, and political circumstances have to be taken into account. This paper addresses the chances and challenges of supply chain management and logistics in Sub-Saharan Africa with a special view to the processes from the Cameroon seaport in Douala to the Hinterland. The seaport in Cameroon is representative for other African seaports, because it is important for the own country but also for people and countries in the Hinterland – e.g. Chad. Similar problems, such as long delivery times, do also occur in the supply chains of other African countries, e.g. in Tanzania with its seaport in Dar es Salaam. In this paper the authors aim to make a supply chain in Cameroon visible from the seaport in Douala to the Hinterland. The standard process-model BPMN is used to build up the model. The modelling of the status quo is useful to understand African supply chains with its weaknesses and strengths and to enhance logistics and supply chain management in African countries. With the modelling and its practical improvements a better supply of people in need in Cameroon and other African countries with food, medicines and other goods is aspired. Literature and statistics analysis, former experiences in humanitarian logistics research, first on-location inspections in Africa and detailed interviews of experts in Cameroon are important sources of this paper.

### **Challenges for countries in Sub-Saharan Africa with a special view to Cameroon**

Winner of the peace Nobel Prize Wangari Maathai describes in her book “The Challenge of Africa” (Maathai 2010) in a traceable way a traditional African stool, which is comprised of a seat and three legs: Within the picture of a three leg stool

- the first leg represents democratic space, where rights are respected,
- the second leg symbolizes the sustainable and fair management of natural resources, and
- the third leg stands for the culture of peace in form of fairness, respect, compassion, forgiveness, recompense, and justice.

The three legs of the stool support the seat, which represents the milieu in which development can take place. In Africa today, a number of countries are trying to balance on two or less of the stool’s three legs. “It is essential to recognize when one or more of the three pillars is absent, and accept that, no matter how many funds are provided, in a country that is balancing on two, one or no legs, the money may not only be wasted or have only a temporary effect, but may even contribute to the continuing instability of that society (Maathai 2010, p. 58).” Maathai describes several examples, especially from Sub-Saharan Africa and necessary measures to overcome such situations. This is a wide view on the macro-level of the challenges of Sub-Saharan Africa challenges. We should bear them in mind when dealing with humanitarian logistics in Africa.

Going more into detail with view to consequences of instability and other special circumstances in Sub-Saharan Africa, several statistics describe the actual situation these countries and their people face. The World Health Statistics 2014 published by the World Health Organization (WHO) is one of the central statistics with view to health, nutrition, and other central information with relevance for humanitarian aid and humanitarian logistics. This report and statistics also address the eight UN Millennium Development Goals (UN MDG) as they have been defined in the year 2000 and as they are planned to be met until the year 2015 (see more details under [www.un.org/millenniumgoals/](http://www.un.org/millenniumgoals/)). But with a special view to Africa and Sub-Saharan Africa several goals will not be fulfilled until 2015, e. g. the reduction of poverty, malnutrition, and hunger. In addition there are still enormous differences between the worldwide regions. For example the risk of a child dying before the fifth birthday is still highest in the WHO African Region (95 per 1000 live births) – eight times higher than that in the WHO European Region (12 per 1000 live births, WHO 2014, Bölsche et. al. 2014). Sub-Saharan Africa faces the highest rate of worldwide deaths regarding vaccine-preventable diseases. More than 2.4 million children are killed annually and millions more get permanently impaired due to missing health treatments (Village Reach 2014).

The following table 1 summarizes important findings from the World Health Statistics 2014 with a comparison between Africa, America and the global situation. In addition the first column represents Cameroon as one example from Africa. The data represent the actual situation within the sectors health, nutrition, sanitation, education, technic and others and refer to the *eight UN MDGs*. Lower life expectancy, higher mortality and malnutrition rates, lower educational level, less people living in urban areas – all these are situations for African countries in comparison to the global situation, especially in Sub-Saharan Africa.

	Cameroon	African Region	Regions of America	Global
<b>Life expectancy</b> 2012 at birth (WHO 2014, pages 60, 68), (male / female)	56 (m 55/ f 57)	58 (m 56/ f 59)	76 (m 74/ f 79)	70 (m 68/ f 73)
<b>Infant mortality rate</b> 2012, probability of dying by age 1 (by age 5) per 1000 live births (WHO 2014, pp. 61, 69) → MDG 4 “Reduce child mortality”	age 1: 61 age 5: 95	age 1: 63 age 5: 95	age 1: 13 age 5: 15	age 1: 35 age 5: 48
<b>Maternal mortality ratio</b> per 100000 live births 2013 (WHO 2014, pp. 74, 90) → MDG 5 “Improve maternal health”	590	500	68	210
<b>Cause specific mortality rate</b> per 100000 population 2012 (WHO 2014, pp. 74, 90) → MDG 6 “Combat HIV/AIDS, Malaria and other diseases”				
- HIV/AIDS	159	377	20	56
- Malaria	56	63	0.1	11
- Tuberculosis	29	26	2	13
<b>Numbers of reported cases, here Malaria</b> 2012 (WHO 2014, pp. 94, 102)	313 315	77 079 733	143	89 194 435
<b>Total expenditure on health</b>				
- as % of GDP 2011	5.4	6.2	14.1	9.1
- per capita (US \$)	64	99	3482	1007
(WHO 2014, pp. 142, 143, 150, 151)				
<b>Underweight children</b> aged < 5 years, in % 2006-2012 (WHO 2014, pp. 118, 126) → MDG 1 “Eradicate extreme poverty / hunger”	15.1	24.6	2	15.1
<b>Population living on less than one \$ a day,</b> in % 2006-2012 (WHO 2014, pp. 167, 175) → MDG 1 “Eradicate extreme poverty/hunger”	9.6	51.5	5.1	21.5
<b>Population using improved</b>				
- drinking water				
- sanitation				
in % 2012 (WHO 2014, pp. 118, 126) → MDG 7 “Ensure environmental sustainability”	74 45	66 33	96 88	90 64
<b>Primary school enrolment</b> rate, in % 2006-2012 male / female (WHO 2014, pp. 167, 175) → MDG 2 “Achieve universal primary education”	m 97 f 86	m 81 f 77	m 95 f 96	m 92 f 90
<b>Cellular phone subscribing</b> per 100 population 2006-2012 (WHO 2014, pp. 167, 175) → MDG 8 “Global partnership for development”	60	61	104	89
<b>Living in urban areas,</b> in % 2012 (WHO 2014, pp. 166, 174)	53	39	80	53

Table 1: Central findings from the WHO Statistics (WHO 2014) with reference to UN MDGs

Other important statistics for humanitarian logistics and supply chain management describe special situations in the aftermath of disasters which occur either permanent (e.g. droughts) or acute (e.g. volcanic eruption or flood). Droughts are the most frequent kind of disasters in Sub-Saharan Africa. Experiences from the past show that the negative impacts on the population are particularly high in countries with situations of political instability, crises or war. In comparison to more industrialized continents like Europe and Northern America, the impacts in Africa are significant higher numbers of deaths and victims in case of a disaster and significant lower economic damages (see table 2, Guha-Sapir et. al. 2014; www.em-dat.be; Buatsi 2014).

	Africa	North-America
Occurrence (amount)	72	92
Victims (amount in million)	30	9
Economic damage (US \$ billion)	1.24	66.16

Table 2: Natural disasters and impacts, annual average 2003-2012 (Guha-Sapir et. al. 2014)

When dealing with African supply chains and humanitarian logistics in Africa it is essential to know the situation, challenges and special circumstances in these countries. For instance the information about the dimension of health and malnutrition, rate of population living in urban areas, the spread of mobile phones and other technics are important to know for the supply of food and medicines. Other important information concerns the infrastructural conditions at the seaports and within the countries, here in Cameroon with the seaport in Douala and the infrastructure in the hinterland.

#### **African supply chains – the role of humanitarian logistics and logistics performance**

Humanitarian logistics is defined “as the process of planning, implementing and controlling the efficient, (cost-) effective flow and storage of goods and materials, as well as related information, from the point of origin to the point of consumption for the purpose of alleviating the suffering of vulnerable people. The function encompasses a range of activities, including preparedness, planning, procurement, transport, warehousing, tracking and tracing, and customs clearance (Thomas et. al. 2005, p. 2).” This definition is adopted by several authors and organizations (e.g. Blecken 2010; Bölsche et. al. 2014).

The aims and goals are part of the definition: “efficient, “effective” and “for the purpose of alleviating the suffering of vulnerable people”. For most humanitarian organisations a high logistics service has a higher priority than the logistics costs. With a good or even optimal logistics service, the supply is quick, save and reliable. If the right goods (e.g. food and medicines) are received by the right people (the most affected people and people in need), at the right place, at the right time (as fast as necessary) and with the right quality (e.g. high quality of food items or medicine even in situations of extreme weather), then humanitarian logistics can contribute to alleviate the suffering of vulnerable people. Often it even can save lives. The “right” logistics costs (e.g. for infrastructure, human resources, food and non-food items) are part of the aims, as well. If humanitarian organizations lower the logistics costs, they can use the budget for the core tasks of humanitarian aid. With this, the aim for humanitarian logistics can be defined as

maximizing logistics services under the restriction of given logistics costs (e.g. Bölsche et. al. 2014). In developing countries with situations of hunger and poverty, logistics and supply chain management must address these aims of humanitarian logistics. In consequence we must have these aims in mind when dealing with African supply chains even though it is well-known that private profit-oriented companies differ from these humanitarian aims and tasks.

In 2014 the World Bank published the new Logistics Performance Index (LPI) which compares the logistics performance of 160 countries in the world regarding six components (Arvis et. al. 2014; lpi.worldbank.org/).

- 1) Efficiency of the clearance process (i.e. speed, simplicity and predictability of formalities) by border control agencies, including customs
- 2) Quality of trade and transport related infrastructure (e.g. ports, roads, IT)
- 3) Ease of arranging competitively priced shipments
- 4) Competence and quality of logistics services (e.g. transport operators)
- 5) Ability to track and trace consignments
- 6) Timeliness of shipments in reaching destination within the scheduled or expected delivery time

In the LPI report they are given on a scale (lowest score to highest score) from 1 to 5 for the 160 countries (world), regions and income groups. In table 3 the scores for Cameroon on rank 142 and Sub-Saharan Africa are given and compared to the higher ranked industrialized countries USA (rank 9) and Germany (rank 1). The logistics performance indicator LPI and its score is the weighted average of the country scores on the six key dimensions (for detailed description and calculation see Arvis et. al. 2014).

One of the problems most countries in Sub-Saharan Africa face is the lack of connectivity within supply chains and global networks. Visibility, transparency and controllability of supply chains do not exist. This leads to congestions of sensitive hubs (like ports and central distribution hubs), long leading-times and high costs of operation (Arvis et. al. 2014; Buatsi et. al. 2014; Kessler 2013).

	<b>Cameroon (Rank 142)</b>	<b>Sub- Saharan Africa</b>	<b>USA (Rank 9)</b>	<b>Germany (Rank 1)</b>
1) Customs	1.86	2.27	3.37	4.10
2) Infrastructure	1.85	2.27	4.18	4.32
3) International shipments	2.20	2.49	3.45	3.74
4) Logistics competence	2.52	2.41	3.97	4.12
5) Tracking & tracing	2.52	2.48	4.14	4.17
6) Timeliness	2.80	2.84	4.14	4.36
<b>LPI score</b>	<b>2.30</b>	<b>2.46</b>	<b>3.92</b>	<b>4.12</b>

*Table 3: Key findings from the Worldbanks LPI, scores from 1 (lowest) to 5 (Arvis et. al. 2014)*

Reasons for that can be found on a wider macro-level in the financial and political situation of many African countries, the above mentioned picture of “stools with less than three legs” and the consequences. Transporting, storing and distributing products within African developing countries are often inefficient and ineffective, as transport networks, means of transportation, appropriate warehouses with appropriate equipment, IT-

infrastructure and well-educated personnel are missing. Corruption, high bureaucracy, unstable, extreme weather conditions and daily power failures due to a fragile electricity network aggravate the situation (see e. g. Buatsi 2014).

The following pictures give an insight into typical Sub-Saharan African supply chains from the seaports to the hinterland – starting with the situation at the seaport. Figure 1 shows examples of an insight of goods in transit in Africa with a view inside one of the main ports. The pictures give impressions of weather conditions – heat and humidity – with effects on the road conditions. The technical solutions at the port are different from the automated ones in industrialized countries with effects, especially on the delivery time but also on other logistics performance indicators.



*Figure 1: Impressions from one of the main African seaports (pictures own source from 2013)*

A view to the later processes in the hinterland documents examples for further weaknesses. Figure 2 shows an example of a central warehouse in Cameroon: The walls show water stains and the storage of boxes is not as accurate as required from a logistics experts' point of view.



*Figure 2: Example of a central warehouse in Cameroon (pictures own source from 2013)*

Figure 1 and 2 give an insight into some first introducing examples. Warehouses in rural areas are even built in a more simplistic way than the central one which is shown in figure 2 (for detailed description see e.g. Kessler 2013, Maathai 2010, Schöpferle 2013, Schumann et. al. 2014).

As the introducing chapters of this publication show, there is a need to enhance logistics performance in African supply chains. On-site inspections and interviews with non-

governmental organizations NGOs and logisticians in Sub-Saharan Africa verify the identified need. Because of the significance of the seaports and the transport of imported goods from the main seaports to the people in rural areas, the following model of African supply chains focuses on the processes from the seaport to the hinterland. It makes the logistical processes transparent and lays the foundation for further analyses and improvements.

### **Modelling African supply chains with BPMN – the case Cameroon**

The authors aim to analyze the situation of logistics and supply chain management in Sub-Saharan Africa more detailed starting at the seaport and ending with the recipients. Whereas the presented indicators from WHO and Worldbank are summarized ones, this model goes more into detail, analyzing the processes at the seaport and the following detailed ones to rural areas. For the model the authors have chosen the Business Process Model and Notation (BPMN) with its flow objects, connecting objects, pools, swim lanes and artifacts (for detailed description, see BPMN literature such as Silver 2011 and [www.bpmn.org](http://www.bpmn.org)). Other standardized models such as the SCOR-model (Supply Chain Operations Reference-model) are not suitable because they are oriented too much on private enterprises with the typical source, make and delivery processes. SCOR's advantages and possibilities with view to performance measures, metrics and benchmarks should be kept in mind when analyzing the modelled African supply chains (see Blecken 2010; Bölsche 2013; [www.supply-chain.org](http://www.supply-chain.org)).

The case of the country Cameroon was chosen because of its huge seaport in Douala and its significance for the hinterland in Cameroon but also for other countries such as Chad or the Central African Republic. With this significance for Sub-Saharan Africa it can be compared with other big seaports as the Dar es Salaam port in Tanzania. In Sub-Saharan Africa the significance of airports and railways is comparatively low. Most international goods are transported via seaports and within Africa most goods are transported by trucks and other vehicles via the road network (Kessler 2013; Schumann et. al. 2014). The situation at the seaport and the road conditions can be compared with other African countries, so that this model can be transferred with specific adjustments to the special processes and circumstances in the respective country.

Beside the literature analysis (e.g. Buatsi 2014, Kessler 2013, Schön et. al. 2014, Schumann et. al. 2014) important sources for the model are on-site inspections in Cameroon in 2013 and expert interviews with logistics service providers, NGOs, UN-organizations and researchers in 2014/2015 in Cameroon. This publication gives a first insight into parts of the model, which will be presented completely at the POMS-conference 2015. It is a first intermediary result which will be worked out and standardized in 2015 with further on-site inspections and interviews at the port of Douala and other involved actors in Cameroon.

As a first overview figure 3 shows all processes from the seaport in Douala to a recipient e.g. in Chad. The most important actors are involved in the process model from the top to the bottom in eight "BPMN pools and swim lanes": Recipient, humanitarian organization, forwarding agent, UN office or embassy, customs authority, port authority, (truck-) carrier and ocean carrier. Parts of the figure are scaled up below in figure 4 and 5 because of the complexity of the whole model. Thus, sections of the supply chain become visible (see red marks in figure 3 which are scaled up in figure 4 and 5).

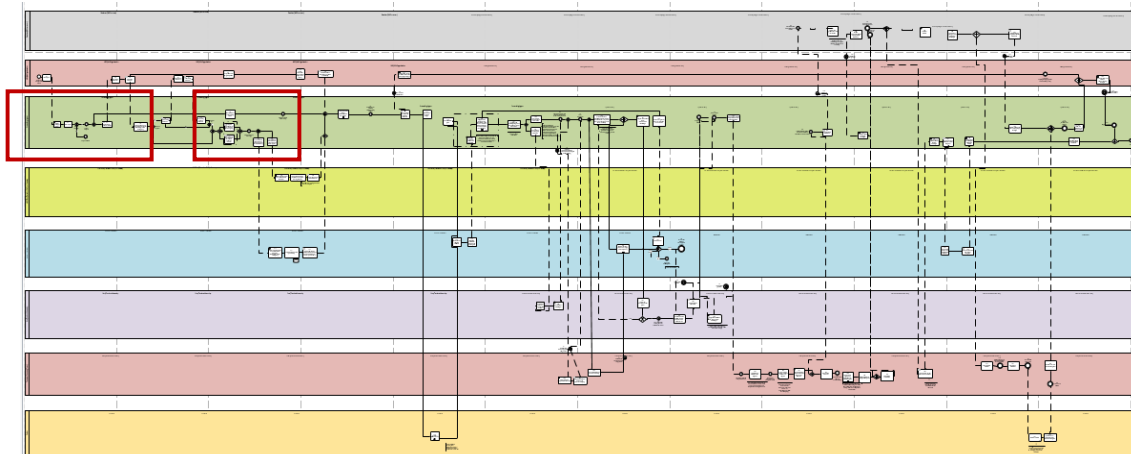


Figure 3: A supply chain model for Cameroon from Douala to the hinterland (own source)

Figure 4 represents the first part of an international supply chain with a request from a humanitarian organization to a forwarding agent, which must be confirmed and checked by the forwarding agent. The figure represents the view to one of the eight “pools and swim lanes” from figure 3, whereas each pool and swim lane represents one actor within the supply chain (here the forwarding agent). Accepted request processes are followed by flow objects, in this case activities, dealing with import documents. All activities, events and gateways are connected via connecting objectives (illustrated by arrows). Two gateways are part of figure 4: One “X” for a decision (XOR) and one “+” for parallel processes (AND).

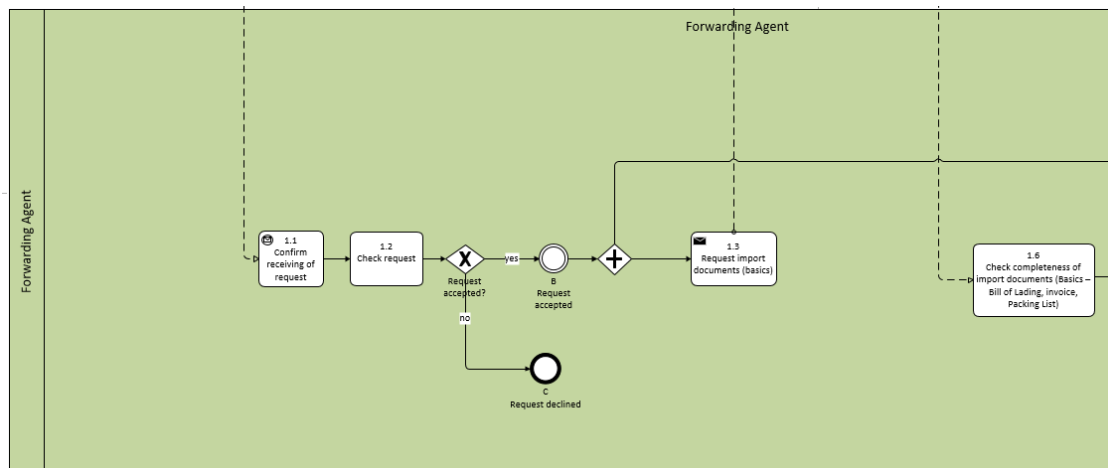


Figure 4: The supply chain model for Cameroon, part 1 (own source)

Figure 5 below represents the second red box from the whole supply chain model in figure 3. The processes are again in the responsibility of the forwarding agent and document parts of the complexity at African seaports (here Douala) with focus on transit documents. These processes are linked within several stages to other actors, such as UN Office / embassy and customs agency. The BPMN model makes bottlenecks and missing effectiveness and efficiency visible. Figure 5 documents just one of several examples where time and money is wasted. High bureaucracy leads to high delivery times and costs (see e.g. Schumann 2014).



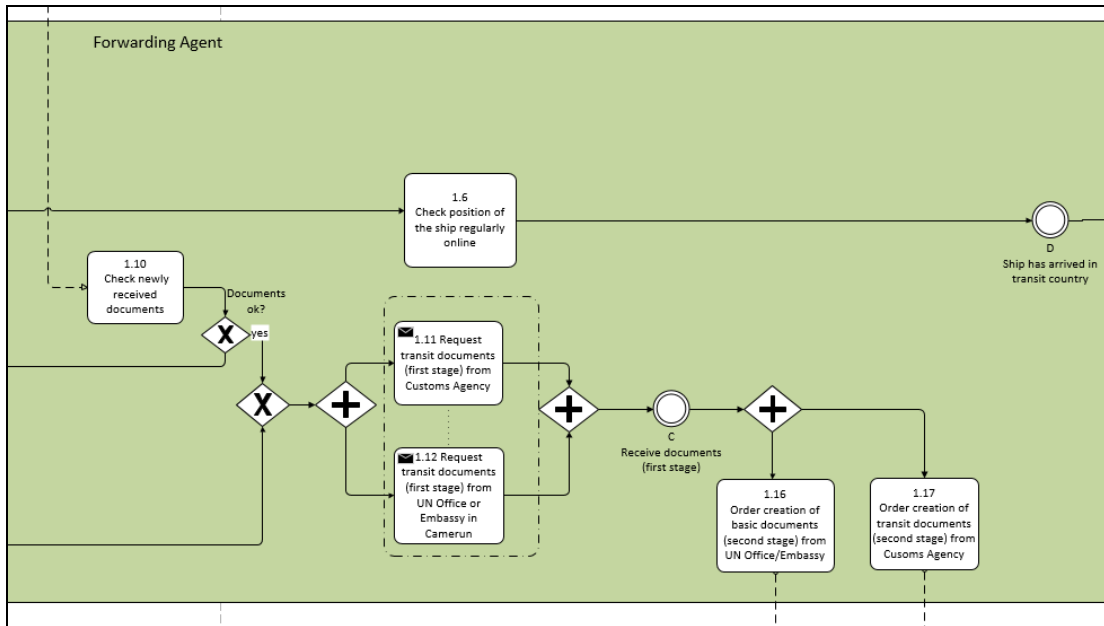


Figure 5: The supply chain model for Cameroon, part 2 (own source)

Combining the modelled processes with knowledge from statistics and experts uncovers existing weaknesses; some of them are summarized in table 5. Bureaucracy and other weaknesses (such as infrastructure, education level, political instability) in Cameroon and other countries in Sub-Saharan Africa result in a three times higher lead or delivery time than in the US and Germany as well as double costs (Arvis et. al 2014).

	<b>Cameroon (Rank 142)</b>	<b>USA (Rank 9)</b>	<b>Germany (Rank 1)</b>
Lead-time port and airport (days)	5	2	2
Lead-time land supply chain (days)	11	3	3
<b>Sum lead-time port and land (days)</b>	<b>16</b>	<b>5</b>	<b>5</b>
Costs* port and airport (US \$)	1817	769	892
Costs land supply chain (US \$)	3464	944	1326
<b>Sum costs port and land (US \$)</b>	<b>5281</b>	<b>1713</b>	<b>2218</b>
*Costs: Typical charge for a 40-foot dry container or a semi-trailer, total freight including agent fees, port and other charges			

Table 5: Import time and costs (Arvis et. al. 2014, pp. 41-43)

### Application and further developments

Currently the logistical processes and supply chains in Cameroon and Sub-Saharan Africa are not visible, neither for actors in industrialized countries nor for most actors within the supply chains who are focused on their own processes and responsibilities. The paper and BPMN-model can be applied by supply chain actors, politicians, and researchers to analyze the existing situation and eliminate identified weaknesses – if desired and possible. So it can be seen as a first intermediate result, which can be used in practice, research and education to

- work out a standardized BPMN-model for Cameroon and / or Sub-Saharan Africa,
- analyze the supply chains and logistical processes and benchmark performance indicators about effectiveness and efficiency of Sub-Saharan Africa, the African continent, of other emerging and developing parts of the world or of industrialized countries,
- benchmark the processes of the different involved actors and enhance coordination and cooperation along the whole supply chain,
- compare the situation at different seaports and for different connections with the hinterland,
- identify weaknesses, but also strengths, chances and risks, to meet the special challenges for Sub-Saharan Africa,
- apply the model and identified improvements in practice,
- train and educate logisticians and other actors in African supply chains, and
- elaborate further research activities.

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