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The new paradigm of cold chain management systems and it's logistics on Tuna fishery sector in Indonesia

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Abstract. The cold chain management is an important element in ensuring standards of quality and safety of fishery products. Global trends of the standard requirements of fishery products (quality, safety and traceability) is constantly increasing and becoming a global effect. These issues make the development of a new paradigm of cold chain system management of Tuna, which must be holistic, integrated and up to date. The results of the reviews of previous studies shows that the application of cold chain management are still partially employed and is not yet fully integrated in the whole process (post harvest handling, processing and packaging, cold storage and distribution, refrigerated transportation, marketing of fishery products). This paper provides a new paradigm of what cold chain management offers by systems integration approach. The output of this integration model will be expected to improve the exports competitiveness of Indonesian fishery products (Tuna`s).
Key Words: cold chain management, Indonesian fishery product, Tuna.

Introduction

Cold chain system application is a way to preserve quality standards and safety of food products. Cold chain system or usually named "cold chain management" is one of cold chain system which is designed to guarantee whole process, starting from capture process/harvest, from cultivation until product distribution until it will be consumed, which will be continuously intact and according to desired functional standards. There are three basic standards: quality, safety and traceability.

One of the most significant constraints is the high level of post harvest losses. Post harvest losses is a result of a poor cold chain implementation in the industry, there are cited fifteen to twenty percent from the primary producer to retail outlet (Figure 1).

Cold chain specifically, a supply chain or logistics network is the system of organizations, human resources, technologies, activities, informations, and resources involved in moving a product or service from supplier to customer. Supply chain activities transform natural resources, raw materials, and components into finished products that are delivered to the final consumer. In sophisticated supply chain systems, used products may re-enter the supply chain at any point where residual value is recyclable.

A cold chain is a temperature-controlled supply chain. It is a concept resulting from specific needs related to the transformation and distribution of temperature-sensitive products (Emond 2008).

To manage the cold chain effectively we need to beware of the drivers for change is along the food supply chain and be able to adapt to them (Davies 2003). Professor Davies (2003) lists of the variables of drivers:

- Consumer tastes and behavior;
- Competition and production efficiency;
- Advances in technology;

- Institutional pressures and regulatory requirements;
- Environmental considerations;
- International and globalization influences;
- Political influences.

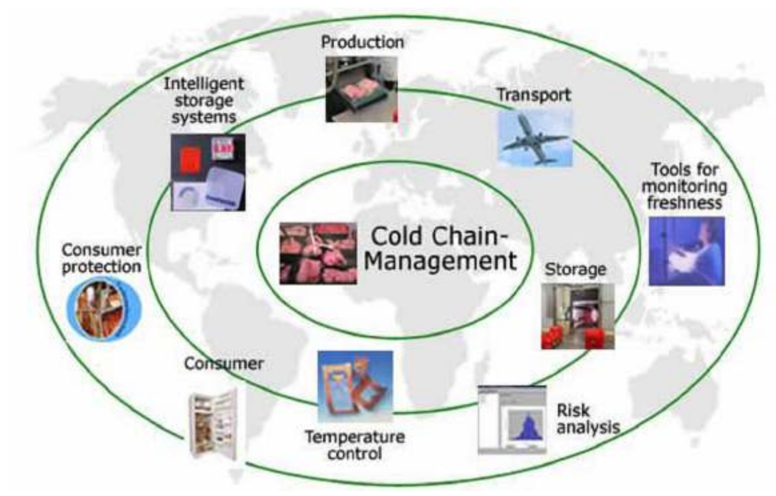

Figure 1. Cold chain management infrastructure components (http://www.iaph.uni-bonn.de/Coldchain/).

Figure 1 shows that cold chain segments cannot be observed/treated apart from the system. They must be considered holistic and integrated, which means that optimization of cold chain system depending on interdependence of variables from each segment and between part towards cold chain system totality.

Indonesian fishery sector. Indonesia is the biggest Tuna-producing country in the world, contributing 15 percent of global Tuna production in 2009, followed by the Philippines, China, Japan, Korea, Taiwan, and Spain. The main commercially caught Tuna species in Indonesia are skipjack (62% of total Tuna landings), yellowfin (29%), bigeye (7%), albacore (1%), and Southern bluefin (1%). The fishing grounds for Indonesian Tuna fall under two convention areas, Indian Ocean and Western Central Pacific Ocean (WCPO). The Western Central Pacific Ocean currently supports the largest industrial Tuna fishery in Indonesia, contributing almost 80 percent of total Indonesian commercial Tuna production, while Eastern Indian Ocean contributes 20 percent (Sustainable Indonesian Tuna Initiative 2011).

Tuna products are the second biggest Indonesian fishery product export item, after shrimp, contributing with 14 percent of total export value, about 352 million USD, in 2009. The main markets for Tuna exported from Indonesia are Japan (35%), the United States (20%), Thailand (12%), European Union countries (9%), and Saudi Arabia (6%) (MMAF 2010).

Indonesia is also one of the major suppliers to markets in the United States and Japan. As the biggest fresh and frozen Tuna supplier to the US, Indonesia contributes about 27% (or about 13 thousand tones) of the total US fresh and frozen Tuna import in 2010, valued at 112 million USD (Indonesian Tuna Fishery Improvement Project 2013).

According to data's to the Indonesian Tuna Supply Chain Analysis (2010), yellowfin Tuna catches has showed downward trend, in 2000, total catch of yellowfin Tuna reached 163,241 tones, but since then it tend to decrease and dropped to 94,406 tones in 2006, though in 2007 it started to recover again with 103,655 tones catch. Indian Ocean (Indian Ocean, Western Timor Sea, Bali Strait and Sawu Sea) used to be the main catching areas for yellowfin Tuna. Almost 54% of total yellowfin Tuna in Indonesia was caught from this area. In the eastern part, Sulawesi Sea and Pacific Ocean was the most important catching areas for yellowfin Tuna, covering 33.7% of total yellowfin Tuna landings, followed by Flores and Makassar Strait (18.2%) and Moluccas Sea, Tomini Bay, and Seram Sea (12.4%) (Figure 2).

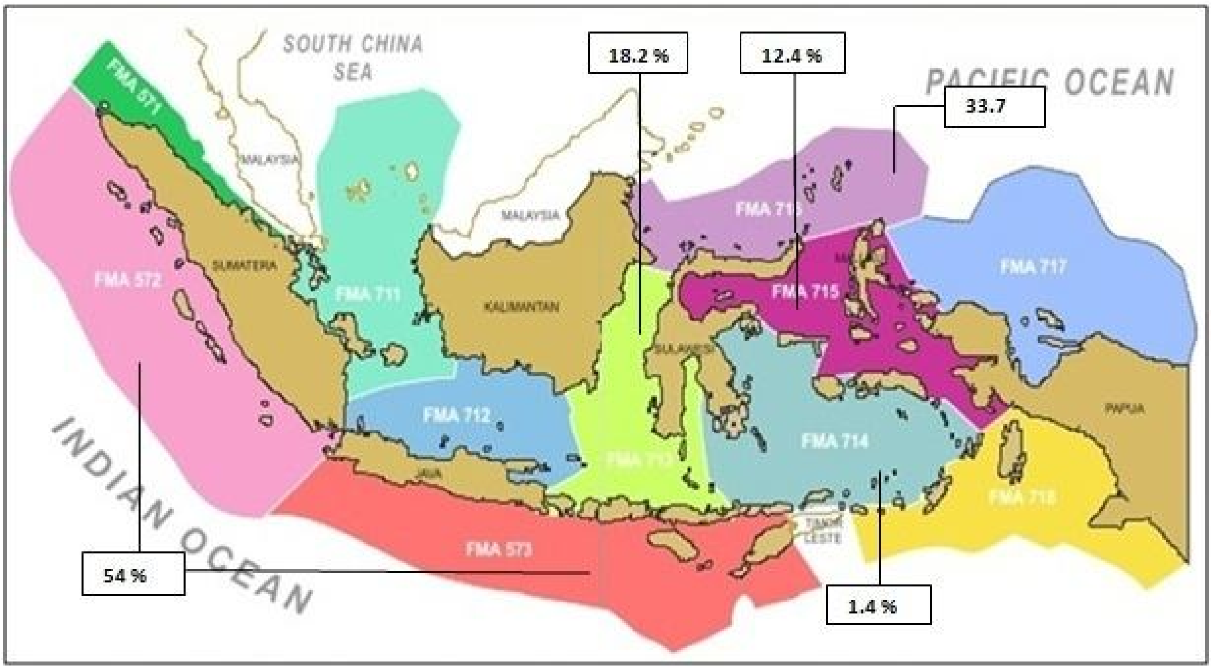

Figure 2. Yellowfin Tuna landing distribution per Fishery Management Areas (FMA) in 2004 (adaptation after Indonesian Tuna Supply Chain Analysis 2010).

In general, Maluku-Papua contributes the biggest landings of albacore, bigeye Tuna, and yellowfin Tuna, with 26% of total Indonesian Tuna landings, followed by North Sulawesi (24%), Bali-Nusa Tenggara (16%), South Sulawesi (12%), North Java (10%), and West Sumatra (8%). It is important to mention that Bali-Nusa Tenggara, North Java, and West Sumatra, the landings also include Southern bluefin Tuna.

Since Tuna resources are abundant and scattered around Indonesian waters, fishing grounds and landing areas of Tuna in Indonesia are dispersed. A significant volume of Tuna is unloaded in Muara Baru (Jakarta) and Benoa (Bali). Three other fishing ports that carry Tuna are Bitung, Ambon, and Sorong (Figure 3).

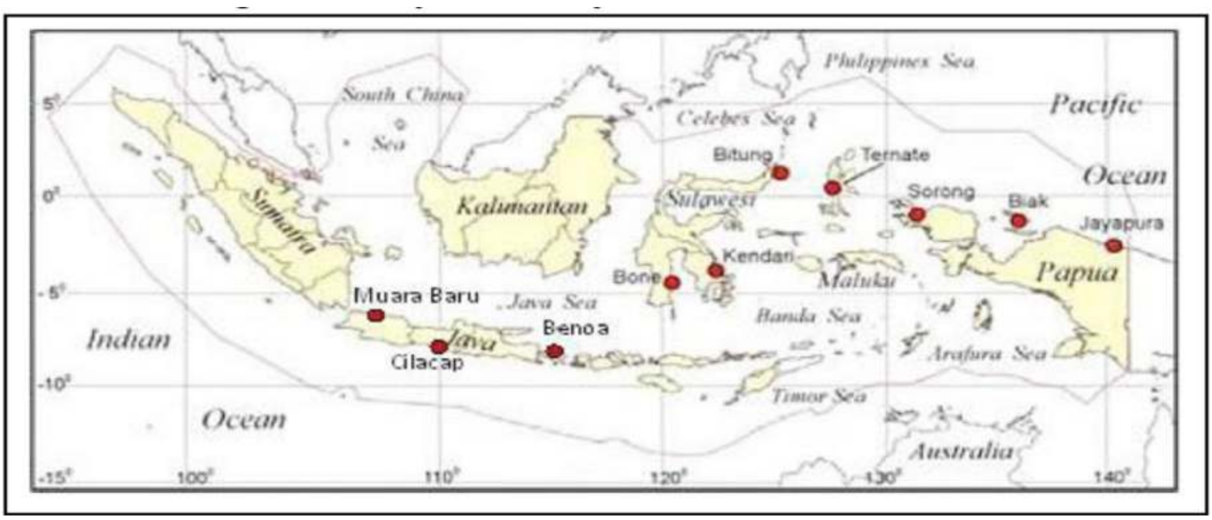

Figure 3. Major ports of Tuna fisheries in Indonesia (Sustainable Indonesian Tuna Initiative, White paper, Sustainable Fisheries Partnership 2011).

Indonesian Tuna supply chain. According to Harland (1996), supply chain is the management of a network of interconnected businesses that meet the main requirements of product and service packages desired by the final consumers. In Tuna supply chain, how to manage a network (fisherman, middlemen, proccessors, wholesalers, retailers, transporters, etc.) from capture to the end of the consumer (from sea to table).

In the Indonesian Tuna value chain, four main categories of operators can be distinguished:

- Fishermen;
- Fish landing sites and ports;
- Middlemen;
- Processors/exporters (Figure 4).

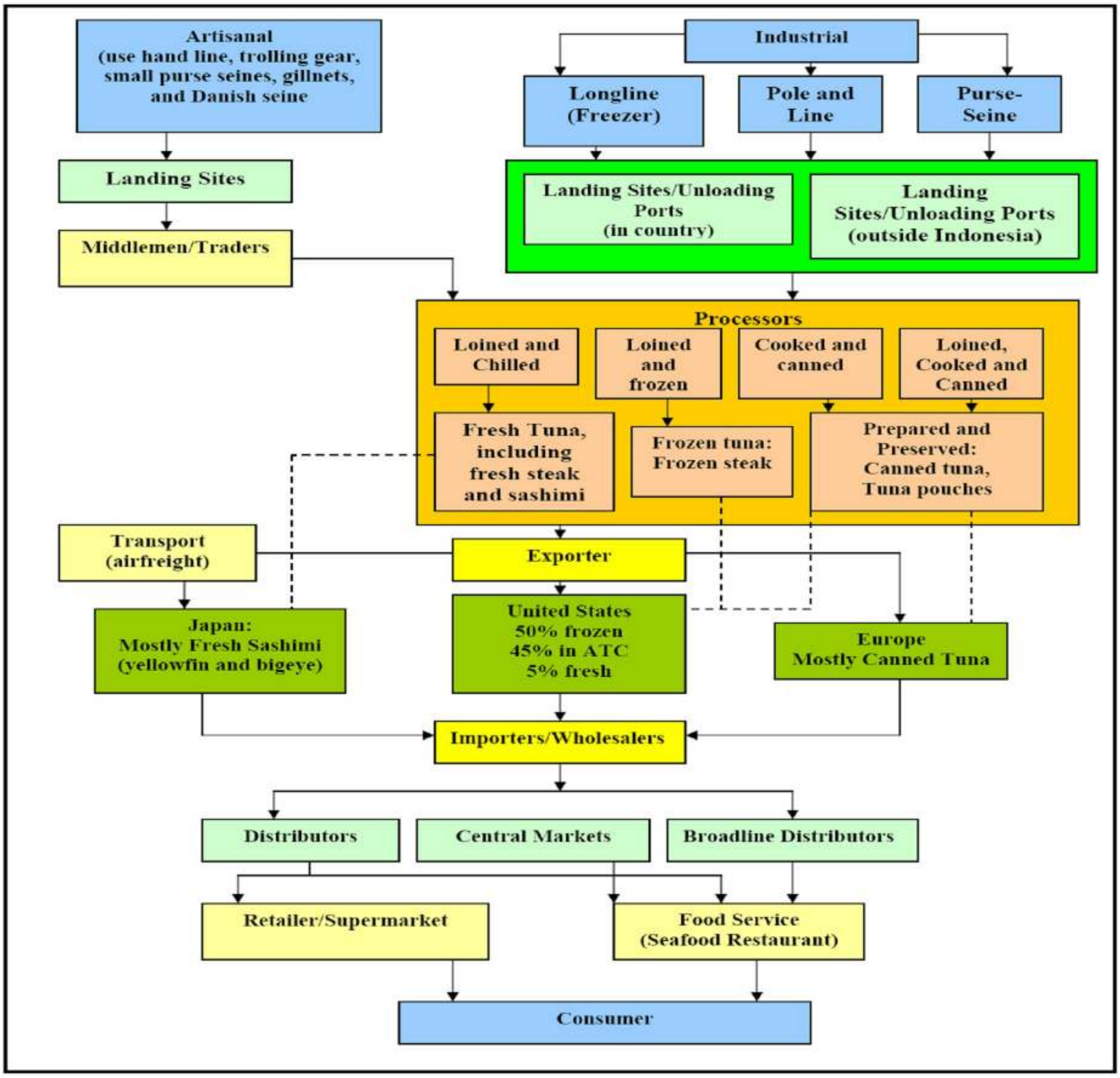

Figure 4. Indonesian Tuna supply chain (Indonesian Tuna Supply Chain Analysis, Sustainable Fisheries Partnership 2010).

It is a relatively common practice in the Tuna industry to undertake all the processing stages up to tuna loining as close as possible to the landing areas and to export the semi-processed product (Tuna loins) to canneries in other countries. The majority of fresh Tuna exsport goes to japan, while for United State 50 % frozen Tuna, 45 % ATC and 5% fresh Tuna. The European Union import more canned Tuna. Mostly of fresh Tuna was generally transported by air as bullets or as loins (Figure 4).

Indonesia contributes about 4% of total global fresh and frozen Tuna exports, exporting about 65.5 thousand tones in 2007, valued at 150 million USD. Indonesia also contributes more than 4% of total global canned Tuna exports, exporting about 52.4 thousands tones in 2007, valued at USD 151.9 million (Sustainable Indonesian Tuna Initiative 2011).

Indonesia was the leader of countries supplying Tuna to Japan (mainly yellowfin and bigeye), sending about 20 thousand tones per year to Japan's market. Indonesia only contributes about 2 percent (9,800 tones in 2008) of total canned Tuna imported to the EU market (Indonesian Tuna Fishery Improvement Project 2013).

Exports of frozen yellowfin Tuna (in various product types) from Indonesia have increased in the last five years. In 2006 the tuna export enriched a value of 13 million USD, while in 2010 the export value increased to more than double up to 31 million USD. Most of the frozen yellowfin Tuna is exported to the US (ITC 2011).

However, MMAF (2010) export statistics show that for the total export of frozen Tuna (yellowfin Tuna as well as other species), export values were significantly higher. In 2010 the export value of frozen Tuna to Japan was at 22 million USD, while exports to the US amounted 18 million USD. Other species that are exported as Tuna will most likely concern bigeye Tuna.

Material and Method. This paper is based on papers review and some fields study. This paper is a continuation of the first paper that was presented in December 2010 in Proceedings of the 2nd International Seminar on Applied Technology, Science, and Arts (APTECS), ITS, Indonesia.

Results and Discussion

Integrity Cold Chain Systems. According to Rodrigue et al (2009) (Figure 5), functionally, there are three elements that integrate within the cold chain system:

- Product. There are some important points of the product element: characteristic of physical attributes, specific temperature and humidity conditions (how perishable and fragile a product can be; how it handles the cold chain process.) Handling process as appropriate of product character is very determining to the quality of products.
- Origin/destination. Origin and destination of product is very important to determine type of handling, especially the dimensions of the distance and the level of difficulty, another hand time dimension along distribution, which can be an important constraint.
- Distribution. Type of product determine the methods and infrastructure available which is appropriate to transport a product in a specific temperature constantly and controlled environment, along refrigerated transport (containers reefers, trucks and warehousing facilities, etc).
- Conditional demand. Each product has important characteristics like specific perishability and level of spoilage. The demand of a product at a market (or place of consumption) are requirements to its qualitative attributes.
- Load integrity. The load unit of refrigerated transport must be relevant with cooling temperature to maintain quality of product belonging to the refrigerated transport (packaging and packing, empty backhauls etc.).
- Transport integrity. Transport integrity has been the setting of specialized modes and terminal facilities specifically designed to support cold chain logistics (Rodrigue et al 2009).

Bootlenecks for the export of Indonesian Tuna. Globalization arise no more limit, both in regional and international medium, but on the other hand the application of determined standard food safety is tight. More stringent standard of food safety applied making no other choice for business community fisheries and the whole stack holder, to try to fulfill the required standard, if they want to keep survive. The cases of rejection of fishery on the destination country exports can be seen in Table 1.

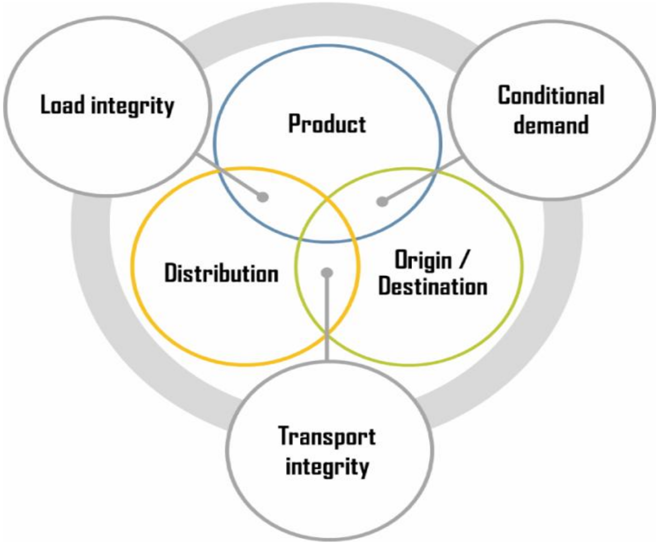

Figure 5. Cold chain system element's (Rodrigue et al 2009).

Table 1

Totality of the rejection cases on fishery products (Ababouch 2006)

Country	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
European Union	127	152	174	429	252	332	259
Japan	-	181	-	-	-	246	29
USA	-	-	667	1927	1505	2282	1644
Canada	170	121	125	174	459	445	404

In the CBI Report (2012) there was some weakness logistics of the system and value chain, especially of Tuna fishery sector in Indonesia. Four different categories of influencers and supporters can be distinguished:

- Government authorities (Ministry of Marine Affairs and Fisheries [MMAF], Ministry of Trade);
- Research institutes (Agency for Marine and Fishery Research and Development, SFP);
- Producer and exporter associations [the Indonesian Tuna Longline Association/ Asosiasi Tuna Longline Indonesia (ATLI), The Indonesian Tuna Association/ Asosiasi Tuna Indonesia (ASTUIN), Association for Fish Processing and Marketing Companies in Indonesia / Asosiasi Pengusaha Pengolahan dan Pemasaran Perikanan Indonesia AP5I)];
- Other supporters and influencers [the Laboratory for the Development and Testing of Fisheries Products / Lembaga Penjamin Mutu Hasil Perikanan (LPMHP), ice factories, Western and Central Pacific Fisheries Commission (WCPFC) and Indian Ocean Tuna Commission (IOTC)].

Six bottlenecks have been identified as a result of the desk study, the field work and the discussions at the strategic conferences:

- Handling and cold storage of Tuna after catching;
- Traceability (EU-catch certificates/E-logbook);
- Eco-labelling;
- Trade barriers of exporting Tuna to the EU;

- Lack of capacity for small/medium processors to do market intelligence;
- Fluctuating Tuna catches.

More clearly can be seen in Figure 6.

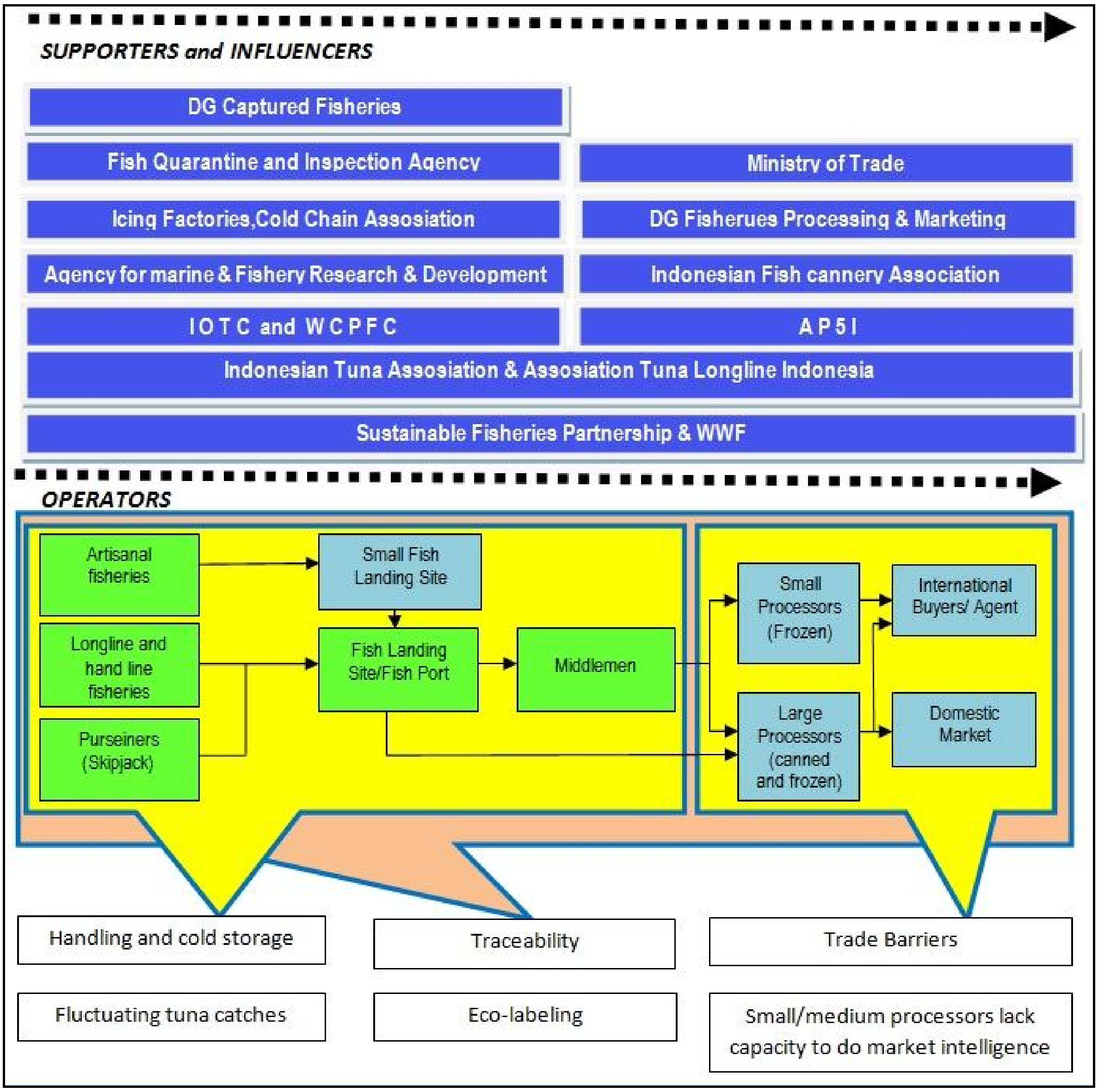

Figure 6. The Indonesian Tuna value chain and its bottleneck (CBI Report 2012).

Risk analysis and HACCP. The following influential factors are considered essentially: Risk Analysis process (Risk Assessment, Risk Management and Risk Communication) and Hazard Analysis Critical Crisis Point (HACCP), which assess and identify threats against of potential dangers that could arise in every stage of a cycle (Lailossa 2010).

The new paradigm changes in the application of Risk Analysis and HACCP should also be an important issue in the application of cold chain systems integration. On the other side of synergism and interaction between government and business must flow in good conditions in the entire cycle from harvest to consumer. Figure 7 present a form of interaction between the government and a food company.

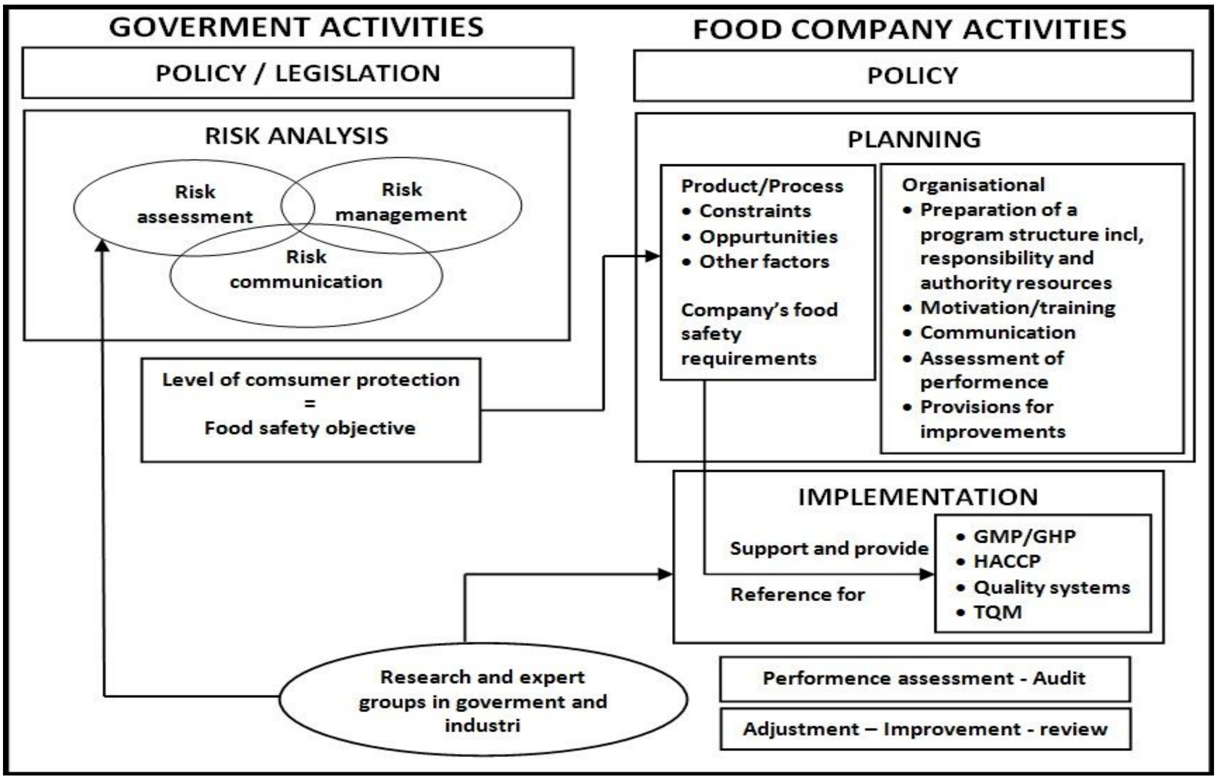

Figure 7. Interaction between the government's and industry's food safety activities, (Huss et al 2003).

Conclusions. Research on modeling of cold chain system, tend to make emphasis on cases which partial means more focus on case model with every partial approach on four primary domain that already displayed above (standard and regulation, risk analysis modeling and cold chain management modeling/refrigerated transport modeling). On the other side, cold chain system is a cycle which is systemic, so that optimization problem from cold chain system cannot be observed as partial from every domain, but must be holistic and systematic (Lailossa 2010).

The study and review show that a new paradigm to developed cold chain system, must be based on the change of the old integrated paradigm, and must generate synergism of the whole stack holder who later apply continuously and consequent the new standards in the whole process starting from harvest until consumption.

The new paradigm of integrated cold chain systems is about how to create integrated model of cold chain systems that have the ability of optimal refrigeration during the process of transport of frozen fish from catching on the sea until arrive at the destination exports country. Refrigeration system must have the capability to maintain the temperature of the products according to standards in charge, and to be able to adapt to the external variables that continue to influence, which sometimes will change even extremely due to the path or track that will be going through during the process of refrigerated transport.

The cold chain systems variables should have the ability to affect favorably the refrigeration during transport due to a temperature difference, to optimize the variables that affected the refrigeration systems due to transport processes that can reduce cooling capabilities which can lower the desired temperature.

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