# Identification of the PLCOR Model for the Management of Product Lifecycle Management Process in Food Industry

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## Abstract

Changes in industrial strategy are due to fast-moving environmental changes. Starting from product innovation, production process to product delivery. The Product Life Cycle Operations Reference (PLCOR) model is a reference model for innovation, product, and portfolio management. The model spans product lifecycle activities from the first idea to broad adoption in the mass market. Nowadays, food industries develop very fast with high innovation ideas, while innovation can disrupt the existing organization. The research aims to identify and prepare the implementation of the Product Life Cycle Operations Reference Model in the food industry, especially in Amplang industry in East Kalimantan. The identification results to implement PLCOR are: (1) need to choose one amplang industry; (2) need to measure the performance of amplang supply chain; (3) need to match the readiness of supply chain with the plan in innovation; (4) need to state the performance indicator for PLCOR based on the life cycle stages; (5) need to discuss the level of disruption that industry can make; (6) need to decide the details obtained from innovation plan.

## Keywords
PLCOR, Innovation, Product life cycle, Amplang, and Food industry

## 1. Introduction

Food industries have become one of an industry that develops with their innovative product in recent years. The environment changes rapidly and affects the behavior and its strategies. It happens through all industry activities along the lifecycle from the first concept to broad implementation and product discontinuation. The key process indicators are creating a new offering, market launch, and deployment and value delivery (Ricken & Meinberg, 2012). Nowadays, the product life cycle becomes shorter, and many businesses strive against survival and growth. A thorough understanding of the market situations and the customers' preferences is needed to meet the market need and satisfy the need of the customer (Kotler, 2000).

Product Lifecycle Management (PLM) for food integrates all aspects of product development within a food organization. It is over formulas of the supply chain such as faired product development, accelerated profit, decreased costs, ensure quality and compliance, and increase the chances of a famous food product (Pinna, Taisch, & Terzi, 2016). PLM allows companies to guide their competitive edge between product cost and performance (Nitha & Sunil, 2017).

In addition, the product life cycle (PLC) concerns changes in sales from the time of its introduction and get the market, the growth, reaching the peak sales, and then the decrease of sales volume (Chen & Chang, 2013). PLCOR

is a reference model for marketing and innovation processes. Product life cycle operation references (PLCOR) implement the concept of disruptiveness to the three execution process types: Create, Go-To-Market, and Deploy (Ricken & Meinberg, 2012).

Amplang is a traditional food from East Kalimantan which is made from fish. It is blended with flour and other ingredients then fried to get crunchy tasteful. Rewards that Amplang is an iconic food in East Kalimantan, this product's innovation has not changed in recent years. But nowadays, due to the rise of competitiveness and disruption in food industries, Amplang industries are innovating and adapting to their environment. They create something new and offer it to the market to survive in competition.

Mostly, amplang is produced by a small and medium enterprise (SME). Small businesses need a product lifecycle management solution designed from the idea that is pre-configured with the industry's best practices and offers fast and affordable deployment. Fully integrated PLM provides what small and medium enterprises need to maximize their innovation strategy and quickly scale to meet their needs tomorrow (Gecevska, Chiabert, Anisic, Lombardi, & Cus, 2010). Higher product variety and innovativeness while keeping manufacturing costs low pushes the food industry to increase its flexibility (Bech, Brunoe, Nielsen, & Andersen, 2019). The competitiveness of a product on the market depends not only on the company that assembles or sells it but also on all companies involved in the manufacturing process of this product and thus its entire supply chain (Bouhaddou, Benabdelhafid, Ouzizi, & Benghabrit, 2012). This study aims to identify and prepare the adoption of PLCOR in Amplang industries in East Kalimantan. The power of the PLCOR model derives from linking process elements, metrics, best practices, and tools and features into a unique format. The PLCOR-model is developed to describe the business activities associated with all product lifecycle stages, from the first idea through market adoption to the end-of-life (Ricken & Meinberg, 2012). It is important to note that PLCOR describes processes, not functions. It focuses on the activity involved, not the person or organizational element performing the activity.

## 2. Literature Review

Usually, radical innovation is not disruptive in all product management processes. It might require a disruptive Go-to-Market process but rely on established processes deployment. Contrary, a disruptive Go-to-Market is not possible for an incremental innovation (Ricken & Meinberg, 2012). For decades, the product life cycle has been used in business strategies like research and development, marketing, and supply chain management. The product life cycle is generally composed of stages that refer to the transition of sales. It varies based on the object of the study (Youssar, 2017). In fact, today, PLM is widely recognized as a business necessity for companies to become more innovative to meet current challenges such as product customization and traceability, growing competition, shorter product development and delivery times, globalization, tighter regulations, and legislation. Being an innovative business does not simply mean creating innovative products. Still, it also means improving the processes a company uses to realize its products and supporting them using innovative approaches for a complete product lifecycle (Corallo et al., 2013). Product lifecycle management (PLM) refers to handling a good as it moves through the typical stages of its product life.

The specified collaboration aspect of defining the PLM may covers: (1) strategic business approach; (2) phases of product lifecycle; (3) a unique and timed product data source; (4) consistency, traceability, and long-term archiving; (5) integrating people, processes, and technologies; (6) collaborating within and across the extended enterprise (Corallo et al., 2013). Based on previous literature, PLM can define and scope in several frameworks. First, the PLM definition is influenced by the company's business and existing products or systems. It is specified the reference context of product classification that exploits by other framework elements. Second, the primary relevance of PLM is focusing on two aspects: the lifecycle phases and the processes. Third, set of configuration management views. It is the most relevant framework for a complex company (Corallo, Lazoi, Lettera, Marra, & Verardi, 2014). PLM enables organizations to acquire competitive advantages by creating a better product in less time, at lower cost, and with fewer scraps than before (Bouhaddou et al., 2012).

The food supply chain, especially in the amplang industry, involves several actors; suppliers of raw material, amplang producers, distributors, retailers, and the end customer (Muriani Emelda Isharyani, Nury Shinta Permata Sari, 2017). The government accompanies the producers to guide the SMEs' development. Some actors impact new product development, while others have a responsibility to develop the product. New product development has been defined as the process of transforming a new market opportunity into a commercial product through a sequence of

activities to achieve specific targets (Azanedo, Garcia-Garcia, Stone, & Rahimifard, 2020). The success in fulfilling user consumption for new product will bring the product strict in the lifecycle stage.

The innovation from the company is to gain and sustain competitiveness. Marketing and innovation management is a trade-off parameter between five performance attributes. Those attributes are (1) reliability, which the right offering will maximize the user value; (2) responsiveness, which minimizes the time to innovate and win market adoption; (3) agility, which is the flexibility to incorporate or improve during the process; (4) cost, which minimize the cost related to innovation tasks; and (5) assets, which minimizes the using of assets employed for innovation (Ricken & Meinberg, 2012).

PLCOR is a reference model for marketing and innovation processes. The PLCOR-model is developed to describe the business activities associated with all product lifecycle stages, from the first idea through market adoption to the end-of-life. As seen in Figure 1, the PLCOR model is managed by the five major process types *Plan, Ideate, Develop, Launch/Go-To-Market,* and *Revise*. In addition, *Enable* processes prepare, manage or maintain policies and information needed in the five major processes.

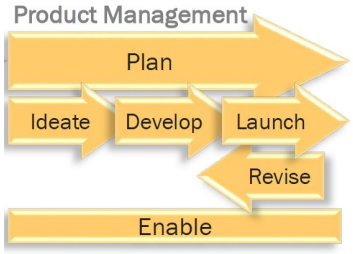


Figure 1. Major processes in PLCOR (source APICS, 2014)

By configuring chains using these process building blocks, the model can describe process lifecycles that are very simple or complex using a standard set of definitions. Every organization that implements innovation and product lifecycle improvements using the PLCOR-model will need to extend the model to at least Level 4. Level 1: scope, content, and performance targets; level 2: configuration level, process category; level 3: process elements; and level 4: plan product portfolio (APICS, 2014).

PLCOR reaches all demand activities, all market interaction, idea management, innovation, marketing, deployment, and any support activities. Table 1 describes the scope of each process type.

Table 1. Process Type of PLCOR

| Process | Description |
|---|---|
| Plan | Portfolio of the future and existing products |
| Ideate | Create idea to concept approval. Including the opportunity to identify and select, concept generation, and concept evaluation |
| Develop | Offering from approved concept to product launch. The 4 Ps are specified and defined, including product development and pricing, positioning, and placement |
| Launch | Release product to customer value. Including go-to-market activities, value communication, and physically deliver the product or give access |
| Revise | Feedback of channel market |
| Enable | Management processes |

The process contribution is measured by metrics that express the overall success across several life cycle stages due to performance attributes. PLCOR applies the concept of disruptiveness to the three execution process categories, as shown in Table 2.

Table 2. Innovation types and processes category

| Innovation Type | Process Categories |
|---|---|
| Radical | Disruptive<br>Adjacent<br>Established |
| Semi Radical | Adjacent<br>Established |
| Incremental | Established |

On PLCOR level 2, processes chain across the stages of the product lifecycle. PLCOR reflects disruption at different phases in the product life cycle. To understand, not every new product always starts with disruptive processes. It can also start with adjacent processes. The success factor is understanding the degree of disruption of every level-2 process. In the first stage (Innovators), processes often have different degrees of disruption. Disruptiveness typically decreases with product maturity towards level 1, as illustrated in Figure 2 (Ricken & Meinberg, 2012).

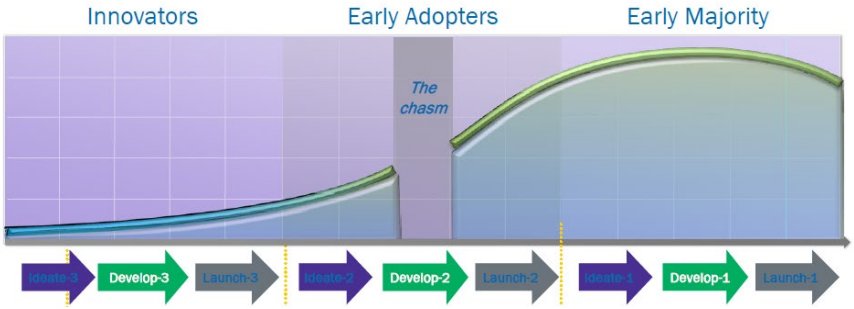


Figure 2. Process Category Along Lifecycle Curve (source APICS, 2014)

Level 3 and level 4 in PLOCR process down is one more level from level 2. It depends on the depth of explanation and evaluation in level 2. Its categories detail each process. The create phase in PLCOR will impacts the planning in the supply chain. Create process turns an idea into an offering that is released to the market. Supply chain capabilities limit the product need to fit into the existing supply chain structure and supply chain cost.

## 3. Methods

In section 1, the paper describes the supply chain management in amplang industry and its interaction with a product life cycle. The methodology to define the supply chain model conducted by descriptive method refers to the food supply chain network framework. In section 2, the general analysis of the amplang life cycle is given. The qualitative method is used to analyze the amplang life cycle. In section 3, the PLCOR for the management of PLM is identified. Even though PLM considers the whole lifecycle of the product, this paper focuses on new development products.

The research focused on amplang industry in East Kalimantan. The data was collected by deep discussion and observation with companies that run the amplang industry. In addition, supply chain data for amplang industry is taken from previous research mentioned in the reference.

## 4. Data Collection

In Section 1, the actors in amplang supply chain are given from previous research; the suppliers, producers, distributors, retailers, and the end customer (Muriani Emelda Isharyani, Nury Shinta Permata Sari, 2017). The relationship between PLCOR and Supply chain is given in Figure 3.

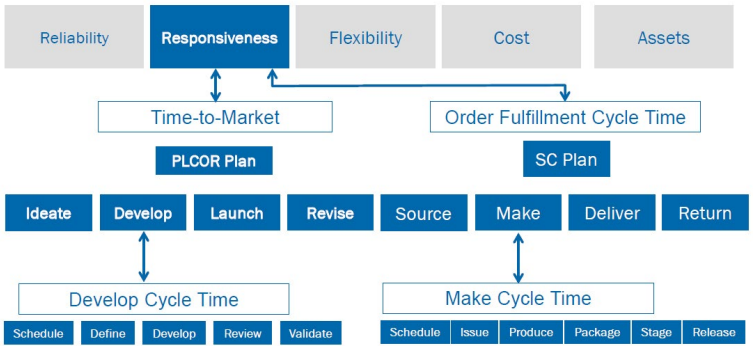


Figure 3. The Linkage Between PLCOR and SC

Level 1 to implement PLCOR is defining scope, content, and performance targets. It is described in Table 3 below.

Table 3. Process in Amplang Industry

| Process | Description |
|---|---|
| Plan | - Extend amplang life cycle time by reproducing, rebranding, repacking, or repositioning with various flavor or raw material |
| Ideate | - Reproduce<br>- Produce various flavors from various raw materials besides fish<br>- Rebranding<br>-Attach another channel distribution and segmentation to reach a wider market by introducing the amplang brand due to its value proposition. Usually, it is followed by developing new packaging<br>- Repacking<br>- Provide range of packaging size and customized related to market. |
| Develop | The most feasible idea to create is rebranding combined with reproducing amplang from other raw materials in recent times. Seafood or other meat can be explored. In the past, some producers had produced amplang in other flavors, but the market's response was not good enough.<br>Lesson learned from this experience: The industry needs to repackage the whole effort to extend its product's life cycle by integrating all activities. The 4 Ps need to specify and defined clearly. |
| Launch | Deliverable that fit customer's want and customer's need. The perfect taste, perfect time, then combined with a perfect marketing strategy, can increase the brand and product awareness for amplang. |
| Revise | In recent years, food product research can be done straight to the market to get feedback to revised. |
| Enable | Management processes that organize all processes; from the initial phase until the end of phase. |

Source: interview

The KPI metrics can be used for the entire product life cycle to measure the performance of the amplang industry processes. Table 4 shown KPI metrics for business objectives.

Table 4. KPI Metrics

| Performance Attributes | Level 1 - Metrics | Explanation |
|---|---|---|
| Reliability | Perfect product launch | Product release on time |
| | Customer satisfaction achievement | Customer perception of product value or usefulness |
| | Product (or brand) | Percentage of repurchase |

| | | |
|---|---|---|
| | loyalty | |
| Responsiveness | Time to a tipping point | Launch of cycle time |
| | Time to volume | % net new customers |
| | Time to market | % net new references |
| Agility | Product launch flexibility | Number of months required to achieve 20% increase |
| | Product launch adaptability | The maximum percentage increase in a year |
| Cost | Operational cost | - |
| Assets | Product ROI | - |

Source: APICS, 2014 (adopted)

In amplang industry, the innovation would not be so radical. Amplang is a traditional food and very familiar to almost all people in East Kalimantan. It is also familiar to given to visitors who came to East Kalimantan. The original taste is the most preferred. But to extend its life cycle and increase the product value, innovation needs to be done—the disruption of amplang industry shown on Table 5 as a stage in level 2.

Table 5. Process Disruption Matrix

| PLCOR | Established | Adjacent | Disruptive |
|---|---|---|---|
| Plan | Customized packing size | Customization and exploration of other raw material | Customers can pick and mix their ingredients, taste, and shape. |
| Develop | Using established communication and distribution channels.<br><br>Using existing design packaging. | - Using new communication and distribution channels that are familiar with the customer, like popular social media nowadays<br>- Targeting a new segment market.<br>- Create a product that still has similarities with the existing one | - Create new communication and distribution channels that are never used by other amplang companies, like using brand ambassador or using advertising service<br>- Create a product that different from the original one. It may be a different shape, different name, or different texture. |
| Launch | Using all chains in the existing supply chain | Customer may request every channel that comfort for them | Engage stakeholders that may contribute to amplang's positioning |

In history, amplang has been made since 1970. It is known as traditional food with crunchy tasteful, made from Belida fish mixed with tapioca flour and other ingredients. Since Belida fish is rare, the raw material is substituted with other fishes like Pipih, Tenggiri, or Gabus. Usually, the shape of amplang consists of 2 (two) types: tube type and tiger claw type (known as Amplang Kuku Macan). There are moments that some producers produce amplang with main ingredients such as seaweed, crab, shrimp, or squid. Also, the artificial flavor added like barbeque flavor, cheese flavor, corn flavor, or chili flavor. Unfortunately, that amplang discontinues fast due to unfamiliar taste to mostly customers contrary to the original amplang that existed for last.

## 5. Results and Discussion

Due to the data collected, the research has reached its purposes—first, the interaction between supply chain management in amplang industry with amplang life cycle. In the supply chain, each plan is influenced by the plan in the first phase of amplang's development, and how the company shares an idea, creates products, or releases it is impacted for an enable phase in the supply chain. The feedback that producers get will be capture as a revised phase

if needed. These are two ways of effect, as seen in Figure 4. For example, extending amplang's lifecycle will change the plan of actors involved along the supply chain. The plan to produce amplang from seaweed will affect the supply chain for supplier whose supply the seaweed material. The number of fish suppliers in the existing supply chain could reduce along with the changes of material used. The interaction between the supply chain and the phases in PLCOR will inform and may change the performance and some details in management and operational ways.

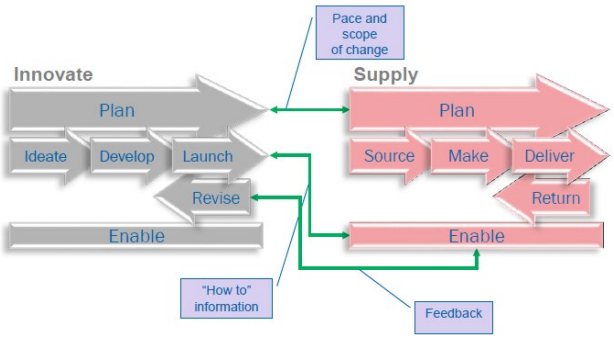


Figure 4. Interaction between Product Life Cycle and Supply Chain

Second, the life cycle for amplang. Amplang is known as an iconic food from East Kalimantan, especially from Samarinda, Balikpapan, and Bontang. Based on observation and interviews with amplang producers, the beginning of amplang is not informed very well. There is no data presented about how long it was initiate and how long it was rise. Over time, traditional food production has given way to more intensive systems characterized (Cucurachi, Scherer, Guinée, & Tukker, 2019). Due to Figure 2, amplang is in the majority stages. The maturity has been achieved for a long time since early 1980 and is still in that position. The innovation needed to extend the length of time of maturity and increase the number of sales. The new product development of amplang will bring a new product life cycle curve for amplang industries.

Third, the PLCOR identification for the management of PLM will start with the concept of PLM used. The PLM framework used in this research focuses on two aspects: the lifecycle phases and the processes. The exact KPI and process disruption matrix could identify details by using the list, prioritized rank, or decision analysis that covers the supply chain limitation. From its characteristics, amplang industry fit adjacent process for the innovation stages. There is local wisdom that brought by amplang so it could not transform drastically. The PLCOR phases and parameters continued to level 3 and level 4 after PLCOR level 2 was listed briefly.

## 6. Conclusions

It is challenging to adopt PLCOR in PLM due to the limitation of previous research. In addition, the framework of PLM has several perspectives. Referring to this research's objectives, the implementation of PLCOR in the amplang industry needs more effort and further research. The identification results to implement PLCOR are: (1) need to choose one amplang industry; (2) need to measure the performance of amplang supply chain; (3) need to match the readiness of supply chain with the plan in innovation; (4) need to state the performance indicator for PLCOR based on the life cycle stages; (5) need to discuss the level of disruption that industry can make; (6) need to decide the details obtained from innovation plan. For further, the research can be done by continuing the conclusion above. Due to a rare reference, this research may give another explanation and perspective to understand PLCOR implementation.

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