

# **System Requirements Document: Global Oil Filter Product Line Family**

**Rev 1.2.2    December 4, 2009**

 **Automotive Corp.**

## **Confidentiality Status**

The content of this document is for external release as example engineering methods information.

For additional information, contact W. D. Schindel, ICTT System Sciences, [schindel@icct.com](mailto:schindel@icct.com) 812-232-2062.

## Table of Contents:

<b>1. Introduction .....</b>	<b>6</b>
1.1 Document Purpose.....	6
1.2 Document Scope.....	6
1.2.1 Document Content Scope .....	6
1.2.2 Intended Audience .....	6
1.2.3 System Location in Enterprise Hierarchies.....	6
1.3 Document Organization.....	7
1.4 Document Management & Revision .....	7
1.4.1 Document Owner.....	7
1.4.2 Approval Process.....	7
1.4.3 Revision Process.....	7
1.4.4 Location and Storage.....	8
1.5 References .....	8
1.5.1 Personnel References.....	8
1.5.2 Information References .....	8
1.5.3 Acknowledgements .....	8
<b>2. System High Level Requirements Framework .....</b>	<b>9</b>
2.1 System Purpose .....	9
2.2 System Stakeholders and Features.....	9
2.2.1 Stakeholders .....	9
2.2.2 Stakeholder Features.....	9
2.3 System Domain (Scope).....	17
2.4 External System Interactions Model.....	18
2.5 System Life Cycle State (Modes) Model.....	24
<b>3. System Detail Requirements Framework.....</b>	<b>26</b>
<b>4. Configured Oil Filter Product Line Portfolio Requirements Population .....</b>	<b>29</b>
<b>5. Appendices .....</b>	<b>31</b>
5.1 Stakeholder Needs.....	31

# Approvals

---

<b>Printed Name</b>	<b>Title</b>	<b>Dept. No.</b>	<b>Signature</b>	<b>Date (DD-Mmm-YYYY)</b>

---

<b>Printed Name</b>	<b>Title</b>	<b>Dept. No.</b>	<b>Signature</b>	<b>Date (DD-Mmm-YYYY)</b>

# Document Revision History

Revision	Revision date	Reason for revision/change request	Revised by
1.1.1 - 1.2.2	08.10.2013 - 08.17.2013	Extract from project-specific and internal documentation	WDS

# 1. Introduction

## 1.1 Document Purpose

The purpose of this document is to define the system high level and detail level requirements for the Global Oil Filter Product Line system family. This document communicates the authoritative generic model within which specific product configurations are defined.

## 1.2 Document Scope

### 1.2.1 Document Content Scope

This document contains (1) the high level requirements family framework, (2) the detailed level requirements family framework, and (3) the family of different configurations of those requirements to cover the desired spectrum of Global Oil Filter Product Line market segments and applications.

This is a technology-neutral document, describing requirements only; refer to the design documentation for technology-specific product designs across the product line.

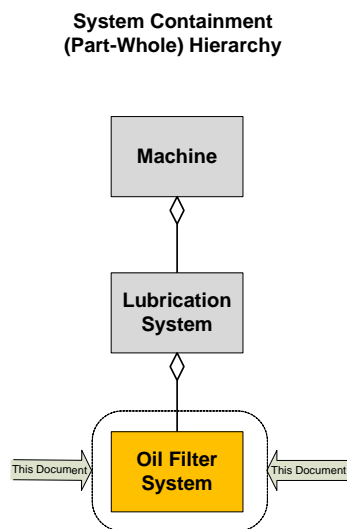
### 1.2.2 Intended Audience

The intended users of this document are (1) marketing product line management, (2) product planners and designers for individual configurations, (3) product test and verification specialists and (4) product distribution system planners.

### 1.2.3 System Location in Enterprise Hierarchies

#### 1.2.3.1 Location in System Containment Hierarchy

The subject Oil Filter System is located in the system containment (part-whole) hierarchy as shown in Figure 1.



**Figure 1: Location in System Containment Hierarchy**

### 1.2.3.2 Location in System Class Hierarchy

This document includes the Oil Filter Product Line Pattern, individual sub-families within it, and specific Oil Filter Product Configurations, as shown in Figure 2.

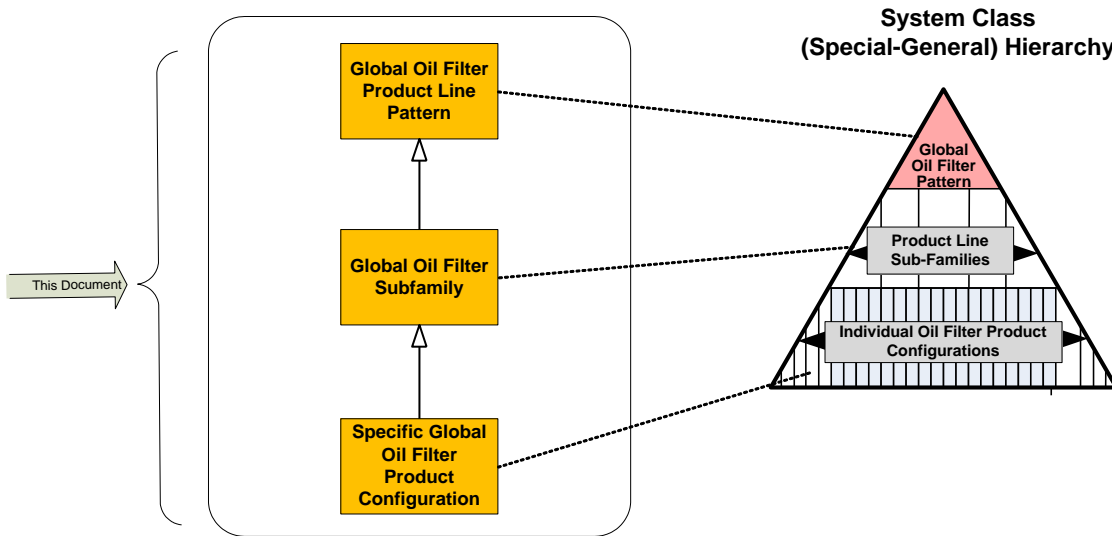


Figure 2: Location in Class Hierarchy

## 1.3 Document Organization

The organization of this document is as follows:

- Section 1: Describes the purpose, scope, organization, and management of this document, and a list of references to people and information.
- Section 2: Summarizes the high level requirements of the subject system family.
- Section 3: Describes the detail requirements of the subject system family.
- Section 4: Describes the specific product configurations within the family.
- Appendix A: Lists stakeholder needs for the subject system

## 1.4 Document Management & Revision

### 1.4.1 Document Owner

The maintenance of the information in this document is the responsibility of [REDACTED].

### 1.4.2 Approval Process

Approval of this document is indicated by signature of the approval blocks shown, in the Engineering Records copy.

### 1.4.3 Revision Process

Revisions of this document are subject to approval. Consult the Engineering Records library for the currently effective, approved version.

#### 1.4.4 Location and Storage

The authoritative current version, as well as previous approved versions, are stored in the Engineering Records library.

### 1.5 References

#### 1.5.1 Personnel References

Name	Role	e-mail	Telephone
[REDACTED]	Document author	[REDACTED]	[REDACTED]
[REDACTED]	Product Line Manager	[REDACTED]	[REDACTED]
[REDACTED]	Product Line Architect	[REDACTED]	[REDACTED]
[REDACTED]	Engineering Manager	[REDACTED]	[REDACTED]
[REDACTED]	Test Methods Specialist	[REDACTED]	[REDACTED]
[REDACTED]	Methodology Consultant	[REDACTED]	[REDACTED]

#### 1.5.2 Information References

1. Anderson, James, “World Mechanical Systems Forecast, 2000 – 2025”, Danson Conference Series, 2005.
2. [REDACTED], “Lubrication Systems Stakeholder Needs Survey”, July 14, 2007.
3. Schindel, William, and Peterson, Troy, “Tutorial: Introduction to Pattern-Based Systems Engineering”, *Proceedings of the 2013 International Symposium*, International Council on Systems Engineering, June, 2013.

#### 1.5.3 Acknowledgements

This document uses Model-Based Systems Engineering and Pattern-Based Systems Engineering methods described by Reference (3).



## 2. System High Level Requirements Framework

### 2.1 System Purpose

The purpose of an Oil Filter System is to remove suspended particulates and other contaminants from circulating lubricant in an in-service mechanical system, to protect and extend the life of that system and enhance its performance. The specific configuration of an Oil Filter System is determined based on the mechanical system, its application, duty cycle, environment, and other factors. The optimized portfolio of different Oil Filter System configurations is planned to cover the targeted market segments and applications.

### 2.2 System Stakeholders and Features

#### 2.2.1 Stakeholders

System stakeholders are the people, groups, and organizations which have a stake in some form of success of the Oil Filter System. The needs of these stakeholders will determine the capabilities of the system. These stakeholder groups for this system are shown in Table 1.

**Table 1: System Stakeholder Groups**

Stakeholder Name	Definition
Machine Owner	The owner of a machine that uses the oil filter.
Machine Operator	The operator of a machine that uses the oil filter.
Machine Maintainer	The person who is responsible for maintaining a machine that uses the oil filter.
Enterprise Shareholder	A person who has an ownership share in the enterprise that manufactures the oil filter.
Product Distribution Channel	The channel through which the oil filter is distributed to commercial and retail outlets.
Machine Supplier	The company that supplies a machine that makes use of the oil filter.
Regional Community	The community nearby a machine that uses the oil filter.

A sampling of the needs of these stakeholders is shown in Appendix A. These are further formalized as Stakeholder Features, in the following section.

#### 2.2.2 Stakeholder Features

Stakeholder Features are formal statements of stakeholder requirements in the language and concepts of those stakeholders. As such, they are not necessarily objective or technically quantified in all cases, but nevertheless describe what must be accomplished in the minds of those for whom it must be accomplished. System Features and their Feature Attributes ultimately define the “trade space” in which all system design trade-offs, optimizations, and other decisions, comparisons, or fitness judgments are expressed and evaluated.

The System Features are briefly identified by Figure 3, and defined in Table 2 :

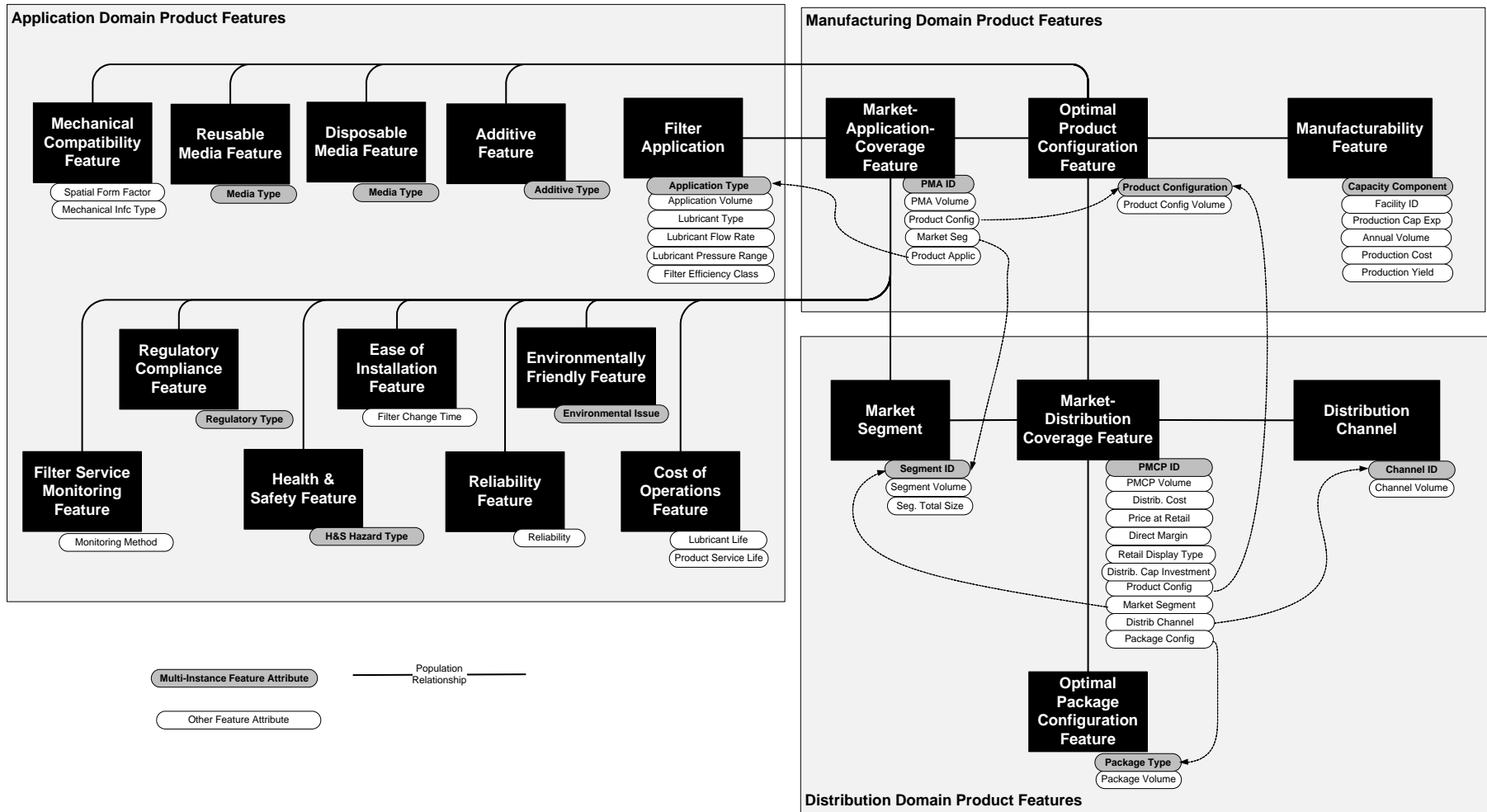


Figure 3: Feature Overview Diagram

**Table 2: Feature Definitions**

<b>Feature</b>	<b>Configuration Population Rule</b>	<b>Definition</b>
Filter Application Feature	One per Filter Application Type	The feature of maintaining a lubricating fluid at a required level of cleanliness while it is in service in a specified application, including the removal of contaminants associated with the application.
Mechanical Compatibility Feature	Mandatory for Oil Filter	The feature of being compatible in form factor and mechanical interface with the system in which the system will be installed.
Cost of Operation Feature	Mandatory for Oil Filter	The feature of supporting cost-effective lubrication of an application, by minimizing the cost of lubrication consumables per operating hour.
Reliability Feature	Mandatory for Oil Filter	The feature of providing services with a specified level of reliability over the normal operating life of a system.
Additive Feature	One Per Additive Type	The feature of automatically adding a chemical additive to lubricating fluid at a specified rate, to accomplish the purpose of the additive.
Environmentally Friendly Feature	One Per Environmental Issue	The feature of having acceptable impact on the natural environment
Regulatory Compliance	One Per Regulatory Issue	The feature of being in compliance with applicable regulations.
Health & Safety	One Per Health & Safety Issue	The feature of protecting people, including those engaged in operation and maintenance of the system, from undue risk of injury caused or preventable by the system.
Ease of Installation Feature	Mandatory for Oil Filter	The feature of being readily installed in or removed from service, in an acceptable time, using expected tools and facilities, by a person with expected capabilities.
Optimal Product Configuration Feature	One Per Product Configuration	The feature of having an optimal portfolio of product physical configurations available.
Market-Application-Coverage Feature	One Per Seg-Applic-Product Combination	The feature of having a product configuration to cover an application in a market segment.
Manufacturability Feature	One per Production Plan Component	The feature of being producible at targeted production volume levels, by effective manufacturing processes, at acceptable levels of quality and production cost, by a given production facility, after investment of plant capital.
Market-Distribution-Coverage Feature	One per Seg-Channel-Package-Product Config. Combination	The feature, for each targeted market segment, of being compatible with associated channels of commercial distribution, including packaging, labeling, transport, storage, tracking, retail display, and sale, at acceptable distribution cost, to achieve targeted market segment business goals.
Market Segment	One per Segment	An identified market segment, based on geography, customer type, or other segmentation of potential customers (except for applications—these are handled separately).
Distribution Channel	One per Channel	A channel for the commercial distribution of product from the point of production to the point of end buyer purchase, including wholesale and retail warehousing, transport, tracking, and transaction support.
Optimal Package Configuration Feature	One Per Package Configuration	The feature of having an optimal portfolio of product package physical configurations available.

The association of Features with the Stakeholders having an interest in them is shown in Figure 4:

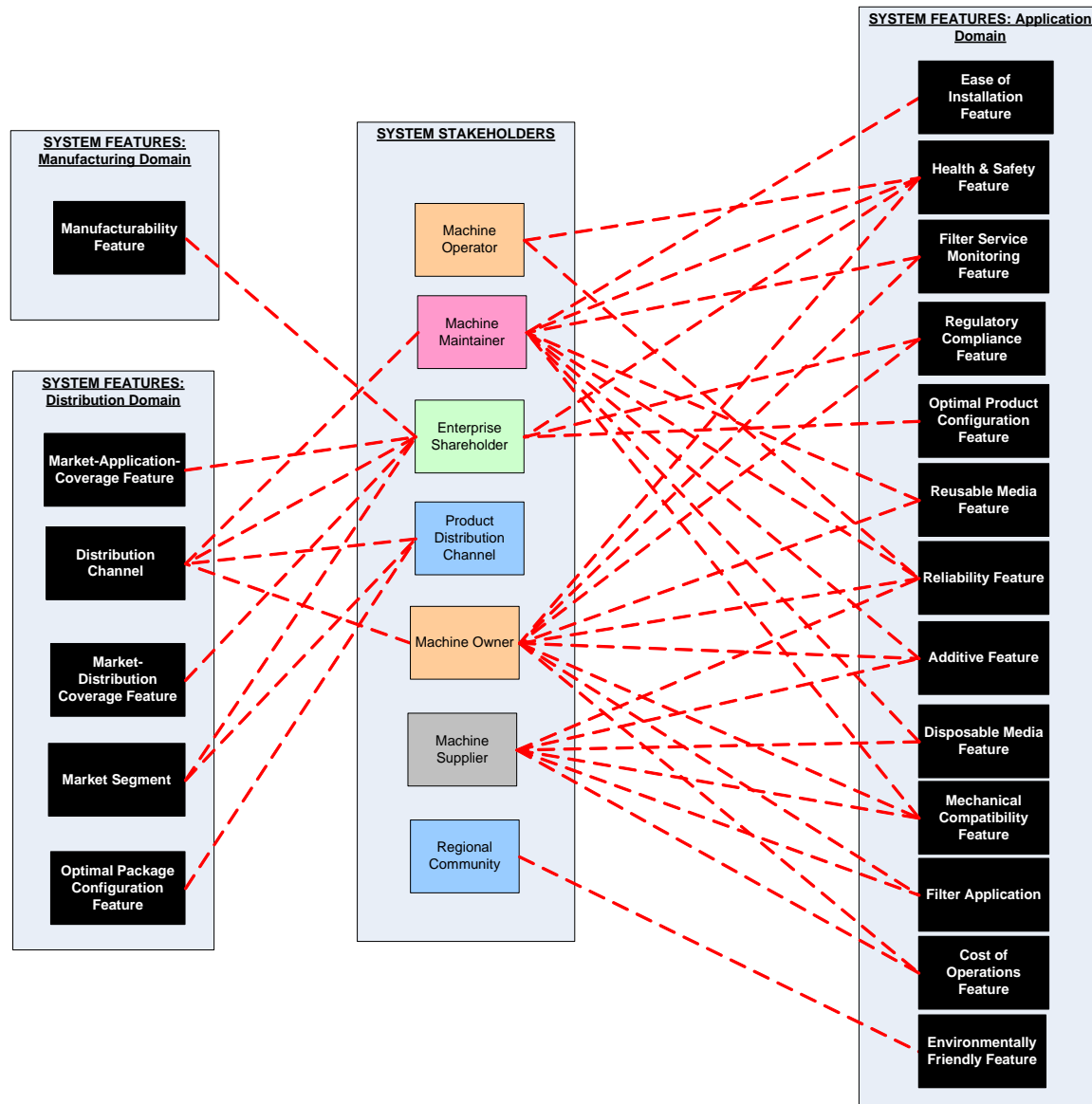


Figure 4: Stakeholder-Feature Associations

Feature values are further specified or quantified by Feature Attributes, which are described in the terminology and concepts relevant to Stakeholders. These are therefore not always technical or objective in nature. The Feature Attributes are described by Table 3.

**Table 3: Stakeholder Feature Attributes**

Feature	Feature Attribute	Multi-Instance	Attribute Definition	Attribute Units	Attribute Values
Optimal Product Configuration Feature	Product Configuration	X	Identifies the configuration of the product, as a model ID. Multiple configurations may be populated.	N/A	
Optimal Product Configuration Feature	Product Configuration Volume		The number of units of this product configuration produced per year.	Units/Year	
Filter Application	Application Type	X	The type of lubricated system application supported by a lubricant filtration system. More than one type may be instantiated for a single product configuration.	N/A	Consumer Automotive, Commercial Automotive, Fixed Base Engine System, Harsh Environment, High Temperature Environment, Cold Environment
Filter Application	Application Volume		The number of units of this application placed into service during a year.	Units/Year	
Filter Application	Lubricant Type		The type of lubricating fluid to be used.	N/A	
Filter Application	Lubricant Flow Rate		The rate at which the lubricating fluid must be circulated in order to meet equipment lubrication objectives.	GPM	High, Medium, Low
Filter Application	Lubricant Pressure Range		The amount of hydraulic pressure under which the lubricant will circulate.	PSI	High, Medium, Low
Filter Application	Filter Efficiency Class		The profile of filtration efficiency provided by the filter	N/A	
Mechanical Compatibility Feature	Spatial Form Factor		The class of three dimensional structure of a component, subsystem, or space within a system reserved for a component or subsystem.	N/A	
Mechanical Compatibility Feature	Mechanical Interface Type		The mechanical class of the interface between the oil filter and the equipment to which it is connected.	N/A	
Cost of Operation Feature	Lubricant Life		The amount of time that a lubricant is intended to operate, meeting requirements within the specified environment, before it is replaced.	Hours	

Feature	Feature Attribute	Multi-Instance	Attribute Definition	Attribute Units	Attribute Values
Cost of Operation Feature	Service Life		The amount of time, in operating hours, that a lubricant filter is intended to operate, meeting requirements within the specified environment, before it is replaced.	N/A	Standard, Long Life
Reliability Feature	Reliability		The percentage of products not failing over the rated service life and application of the product.	Percent	
Additive Feature	Additive Type	X	The type of additive to be added to a lubricant. Multiple types may be populated.	N/A	
Disposable Filter Media Feature	Media Type	X	The type of disposable filter media accommodated by the filter. More than one type may be populated.	N/A	
Reusable Filter Media Feature	Media Type	X	The type of cleanable, re-usable filter media accommodated by the filter. More than one type may be populated.	N/A	
Filter Service Monitoring Feature	Monitoring Method		The type of monitoring method supported by the oil filter.	N/A	In-Service Electronic Sensing, In-Service Manual Inspection, In-Service Pressure Drop Monitoring
Environmentally Friendly Feature	Environmental Issue	X	The type of natural environment issue which the product addresses. More than one value may be populated.	N/A	Lubricant Leakage, Gaseous Emissions, Solid Waste Disposal
Health & Safety	H&S Hazard Type	X	The type of safety issue which the product addresses. More than one value may be populated.	N/A	Sharp Edges, High Pressure Service, Hazardous Materials
Regulatory Compliance Feature	Regulatory Issue	X	The type of regulatory issue which the product addresses. More than one value may be populated.	N/A	Sharp Edges, High Pressure Service, Hazardous Materials, Lubricant Leakage, Gaseous Emissions, Solid Waste Disposal
Manufacturability Feature	Capacity Component	X	Identifies a component of the overall production plan for a given year, across multiple product configurations and production facilities, including capacity updates for that period. Multiple components may be populated.	N/A	
Manufacturability Feature	Production Facility		Identifies a manufacturing facility which will be compatible, possibly through investment of capital, with the required production. More than one value may be populated.	N/A	
Manufacturability Feature	Production Capital Expense		The amount of capital to be invested in the facility, to bring it to the required capability.	US Dollars	
Manufacturability Feature	Production Cost		The direct cost of materials and production of the product configuration, at the targeted annual production volume, including considerations of cost of production capital.	US Dollars	
Manufacturability Feature	Target Annual Production Volume		The annual production volume for the product configuration.	Units/Year	

Feature	Feature Attribute	Multi-Instance	Attribute Definition	Attribute Units	Attribute Values
Manufacturability Feature	Production Yield		The percent of production units for the product configuration which meet quality goals and can enter distribution.	%	
Ease of Installation Feature	Filter Change Time		The amount of time required for a trained service person to remove and replace an oil filter.	Minutes	
Market-Distribution Coverage Feature	PMCP ID	X	Identifies a component of the overall plan of distribution to multiple market segments, through multiple market channels. More than one combination may be populated.	N/A	
Market-Distribution Coverage Feature	PMCP Volume		The targeted volume to be sold to a specific segment through a specific channel using a specific package in a year.	Units/Year	
Market-Distribution Coverage Feature	Distribution Cost		The unit cost to transmit the product through the distribution channel at the targeted channel volume, including costs of shipment, storage, handling, and display, but not advertising.	US Dollars	
Market-Distribution Coverage Feature	Price At Retail		The suggested retail price per unit for end user sale of the product configuration in the distribution channel and market segment.	US Dollars	
Market-Distribution Coverage Feature	Direct Margin		The difference between sales price and cost of production and distribution.	US Dollars	
Market-Distribution Coverage Feature	Retail Display Type		Identifies the type of packaged product display (display type, size, capacity, etc.) used in the identified distribution channel, for the identified product configuration.	N/A	
Market-Distribution Coverage Feature	Distrib. Capital Investment		The amount of capital to be invested in this distribution channel to achieve the results described.	N/A	
Market-Distribution Coverage Feature	Product Configuration		Identifies a configuration of the product, as a model ID.	N/A	Values are chosen from those populated for the Optimal Product Configuration Feature.
Market-Distribution Coverage Feature	Market Segment		Identifies a segment of the market for the products.	N/A	Values are chosen from those populated for the Market Segment feature.
Market-Distribution Coverage Feature	Distribution Channel		Identifies a distribution channel	N/A	Values are chosen from those populated for the Market Segment feature.
Market-Distribution Coverage Feature	Package Configuration		Identifies the type of package (style, capacity, etc.) used in the identified distribution channel, for the identified product configuration.	N/A	
Market Segment	Segment ID	X	Identifies a segment of the market for the products. Multiple segments may be populated.	N/A	
Market Segment	Segment Volume		The volume of product delivered to the market segment.	Units/Yr	

Feature	Feature Attribute	Multi-Instance	Attribute Definition	Attribute Units	Attribute Values
Market Segment	Market Segment Total Size		The total size of the market segment, in terms of number of units it will purchase per year, from all suppliers including competition.	Units/Yr	
Optimal Package Configuration Feature	Package Type	X	Identifies the type of package (style, capacity, etc.) used in the identified distribution channel, for the identified product configuration. Multiple types may be populated.	N/A	
Optimal Package Configuration Feature	Package Volume		Identifies the number of packages of this type that will be consumed annually.	Units/Yr	
Market-Application Coverage Feature	PMA ID	X	Identifies a combination instance of Product Configuration-Market Segment-Application. More than one such combination may be populated.	N/A	
Market-Application Coverage Feature	PMA Volume		The volume of product of this configuration that is consumed by the combined market segment and application.	Units/Yr	
Market-Application Coverage Feature	Product Configuration		Identifies the configuration of the product, as a model ID.	N/A	Values are chosen from those populated for the Optimal Product Configuration Feature.
Market-Application Coverage Feature	Market Seg		Identifies a segment of the market for the products.	N/A	Values are chosen from those populated for the Market Segment feature.
Market-Application Coverage Feature	Product Applic.		The type of lubricated system application supported by a lubricant filtration system. More than one type may be instantiated for a single product configuration.	N/A	Values are chosen from those populated for the Filter Application feature.
Distribution Channel	Channel ID	X	Identifies a distribution channel. Multiple channels may be populated.	N/A	
Distribution Channel	Channel Volume		Identifies the annual volume of units to be distributed through the channel.	Units/Yr	



### 2.3 System Domain (Scope)

A Domain Model describes the environment of a system, specific to a particular Domain. Domains of interest in this case include the oil filter Manufacturing Domain, Distribution Domain, and Application Domain. Each domain model describes the external domain systems (“actors”) with which the subject system physically interacts, across its life cycle, in that domain. The domain model of Figure 5 emphasizes the Application Domain, also briefly summarizing the Manufacturing Domain and Distribution Domain.

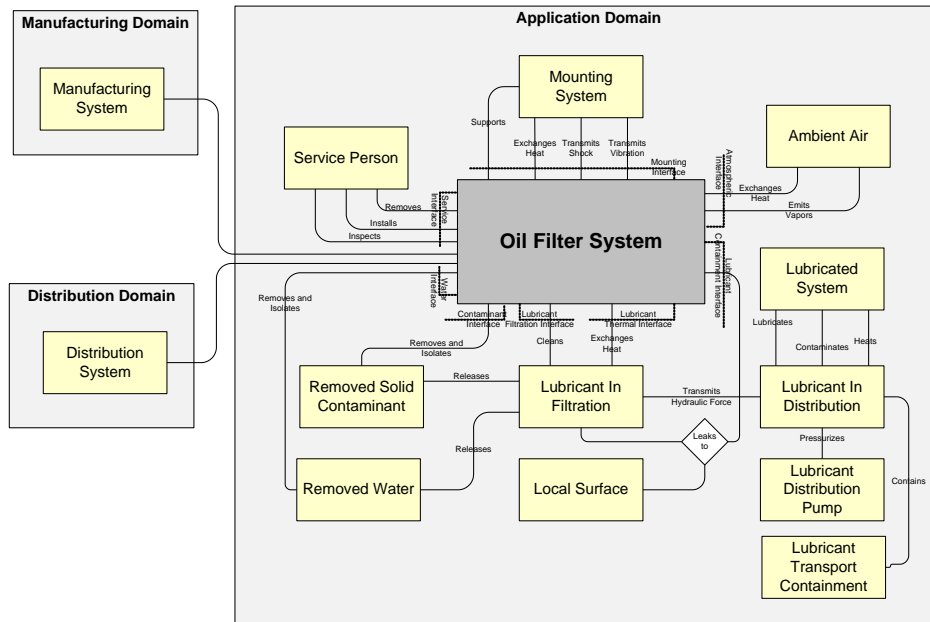


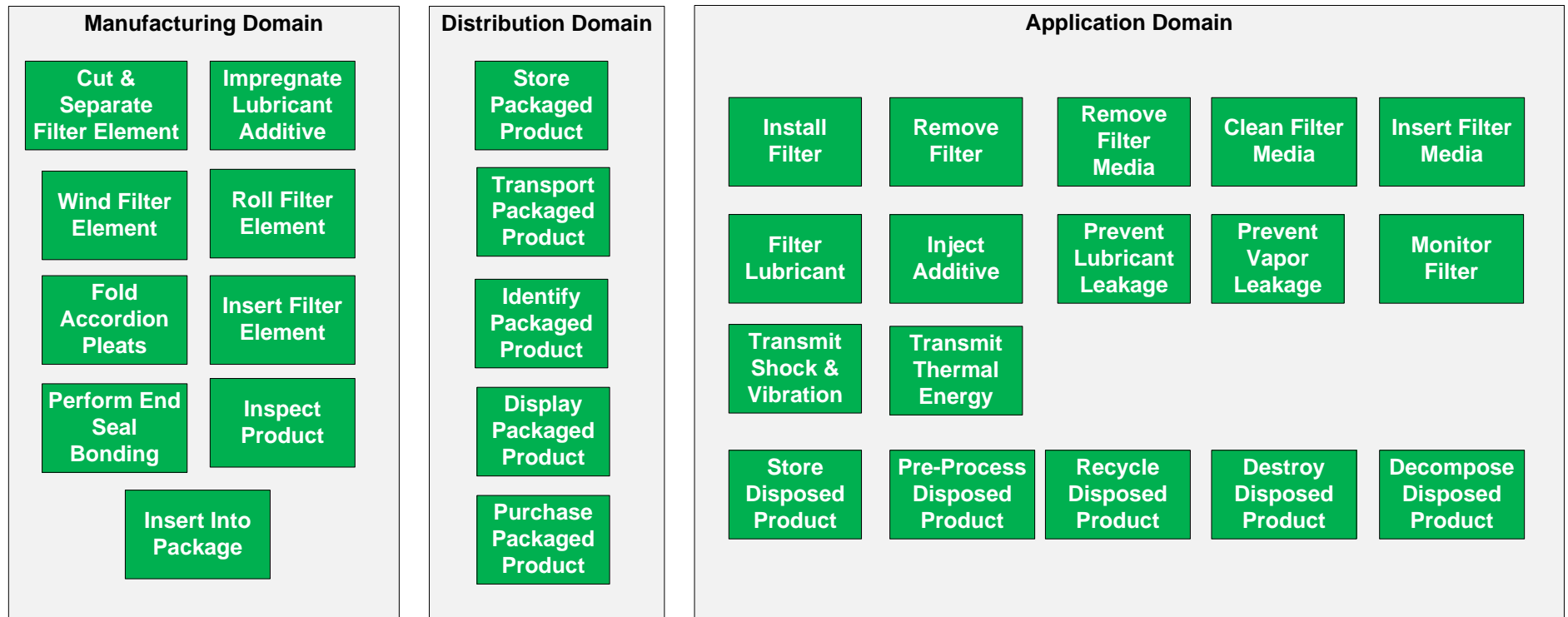
Figure 5: Application Domain Model

Table 4: Domain System Definitions

Domain System Name	Domain System Definition
Oil Filter System	The system which removes suspended particulates and other contaminants from circulating lubricant in an in-service mechanical system, to protect and extend the life of that system and enhance its performance.
Service Person	A person responsible for servicing the oil filter.
Mounting System	A logical system responsible for mechanically supporting the oil filter.
Ambient Air	The air that directly surrounds the system.
Removed Solid Contaminant	The particulate contaminant that is removed from the lubricant by the oil filter.
Lubricant In Filtration	The lubricant that is being filtered by the oil filter.
Removed Water	The water that is removed by the oil filter.
Local Surface	Nearby pavement or other surfaces that are at risk of leakage by the oil filter system.
Lubricated System	A logical system that is being lubricated.
Lubricant In Distribution	The lubricant that is being distributed throughout the lubricated system.
Lubricant Distribution Pump	The logical system responsible for hydraulic forces to transport the lubricant throughout the lubricated system.
Lubricant Transport Containment	The logical system responsible for preventing lubricant leakage in the lubricated machine.
Manufacturing System	The logical system responsible for production of the oil filter, in packaged form ready for distribution.
Distribution System	The logical system responsible for the distribution of the oil filter product from manufacturing to retail.

## 2.4 External System Interactions Model

Figure 6 is an overview of the external Interactions model, summarizing all interactions between the Oil Filter System and the domain systems of Figure 5. These interactions are physical exchanges of energy, force, mass, or information, during which one interacting system alters the state of another. All the functional requirements of the subject system are manifest in these physical interactions. Each interaction is in turn associated with (1) related Features (defining values or “whys”), (2) external interfaces to Actors (indicating “who” is interacting), and (3) States (indicating “when”) the interactions occur.



**Figure 6: External Domain Interactions**

The definitions of these interactions are located in Table 5, which also identifies which external actors (of Figure 3) are involved in each interaction.

**Table 5: Interaction Definitions and Actors**

<b>Interaction Name</b>	<b>Interaction Definition</b>	<b>Oil Filter System</b>	<b>Service Person</b>	<b>Mounting System</b>	<b>Ambient Air</b>	<b>Removed Solid Contaminant</b>	<b>Lubricant In Filtration</b>	<b>Removed Water</b>	<b>Local Surface</b>	<b>Lubricated System</b>	<b>Lubricant In Distribution</b>	<b>Lubricant Distribution Pump</b>	<b>Lubricant Transport Containment</b>	<b>Waste Management System</b>	<b>Manufacturing System</b>	<b>Distribution System</b>	<b>Package</b>	<b>Buyer</b>
Filter Lubricant	The interaction during which the oil filter system filters the lubricant in filtration.	X		X		X	X	X		X	X	X	X					
Impregnate Lubricant Additive	The interaction during which the manufacturing system impregnates the oil filter with lubricant additive.	X													X			
Fold Accordion Pleats	The interaction during which the manufacturing system folds the sheet oil filter element into the form of accordion pleats.	X													X			
Cut & Separate Filter Element	The interaction during which the manufacturing system cuts and separates individual oil filter elements.	X													X			
Wind Filter Element	The interaction during which the manufacturing system winds the fiber oil filter element into a cylindrical shape.	X													X			
Insert Filter Element	The interaction during which the manufacturing system inserts the filter element into the filter housing.	X													X			
Perform End Seal Bonding	The interaction during which the manufacturing system bonds the end seal of the oil filter.	X													X			
Inspect Product	The interaction during which the manufacturing system inspects the finished oil filter product.	X													X			
Insert Into Package	The interaction during which the manufacturing system inserts the finished oil filter product into the package.	X													X	X	X	

Interaction Name	Interaction Definition	Oil Filter System	Service Person	Mounting System	Ambient Air	Removed Solid Contaminant	Lubricant In Filtration	Removed Water	Local Surface	Lubricated System	Lubricant In Distribution	Lubricant Distribution Pump	Lubricant Transport Containment	Waste Management System	Manufacturing System	Distribution System	Package	Buyer
Remove Filter Media	The interaction during which maintainer removes the filter media from the oil filter system.	X	X															
Clean Filter Media	The interaction during which the maintainer cleans the filter media.	X	X															
Insert Filter Media	The interaction during which the maintainer inserts the filter media back into the filter housing.	X	X															
Roll Filter Element	The interaction during which the manufacturing system rolls the sheet filter element into a cylindrical shape.	X													X			
Transmit Shock & Vibration	The interaction during which the oil filter system is subject to, and transmits, mechanical shock and vibration originating externally.	X		X														
Monitor Filter	The interaction through which the service person or lubricated equipment monitors the condition of the oil filter.	X	X															
Prevent Vapor Leakage	The interaction through which the oil filter prevents undue quantities of gaseous vapor contaminants from reaching the external local atmosphere.	X			X													
Prevent Lubricant Leakage	The interaction through which the oil filter prevents undue quantities of lubricant from escape from its portion of the lubrication loop.	X					X		X									
Transmit Thermal Energy	The interaction through which the oil filter receives and transmits thermal energy, originating in external components.	X		X	X		X											

Interaction Name	Interaction Definition	Oil Filter System	Service Person	Mounting System	Ambient Air	Removed Solid Contaminant	Lubricant In Filtration	Removed Water	Local Surface	Lubricated System	Lubricant In Distribution	Lubricant Distribution Pump	Lubricant Transport Containment	Waste Management System	Manufacturing System	Distribution System	Package	Buyer
Install Filter	The interaction through which the service person mechanically installs an oil filter in the system which it is expected to serve, making it ready for service.	X	X	X														
Remove Filter	The interaction through which the service person mechanically removes an oil filter from the system in which it has been installed.	X	X	X		X		X	X									
Store Packaged Product	The interaction through which the the oil filter system, in its distribution packaging, is placed into, resides in, or is removed from storage, including maintaining its security, environmental conditions, and tracking its identity and status.	X														X	X	
Transport Packaged Product	The interaction through which the the oil filter system, in its distribution packaging, is transported from place to place during the distribution process, including maintaining its security, environmental conditions, and tracking its identity and status.	X														X	X	
Identify Packaged Product	The interaction through which the the oil filter system, in its distribution packaging, is identified as to its type (and possibly instance) by people or information systems.	X														X	X	X
Display Packaged Product	The interaction through which the the oil filter system, in its distribution packaging, is displayed in a retail setting for customer selection and purchase.	X														X	X	X

Interaction Name	Interaction Definition	Oil Filter System	Service Person	Mounting System	Ambient Air	Removed Solid Contaminant	Lubricant In Filtration	Removed Water	Local Surface	Lubricated System	Lubricant In Distribution	Lubricant Distribution Pump	Lubricant Transport Containment	Waste Management System	Manufacturing System	Distribution System	Package	Buyer
Purchase Packaged Product	The commercial transaction interaction through which the oil filter system is purchased by a buyer for subsequent use.	X														X	X	X
Store Disposed Product	The interaction through which all or part of an oil filter system that has been removed from service is stored prior to disposal disposition.	X	X											X				
Pre-Process Disposed Product	The interaction through which all or part of an oil filter system that has been removed from service is processed or transformed prior to ultimate disposal disposition.	X	X											X				
Recycle Disposed Product	The interaction through which all or part of an oil filter system that has been removed from service is recycled for some form of reclamation.	X	X											X				
Destroy Disposed Product	The interaction through which all or part of an oil filter system that has been removed from service is destroyed.	X												X				
Decompose Disposed Product	The interaction through which all or part of an oil filter system that has been removed from service is subject to natural decomposition processes.	X												X				
Inject Additive	The interaction through which the oil filter system injects additive material into the lubricant flow stream, for purposes of improved equipment life or performance.	X					X											

Figure 7 indicates the mapping of the above System Interactions to the above Stakeholder Features.

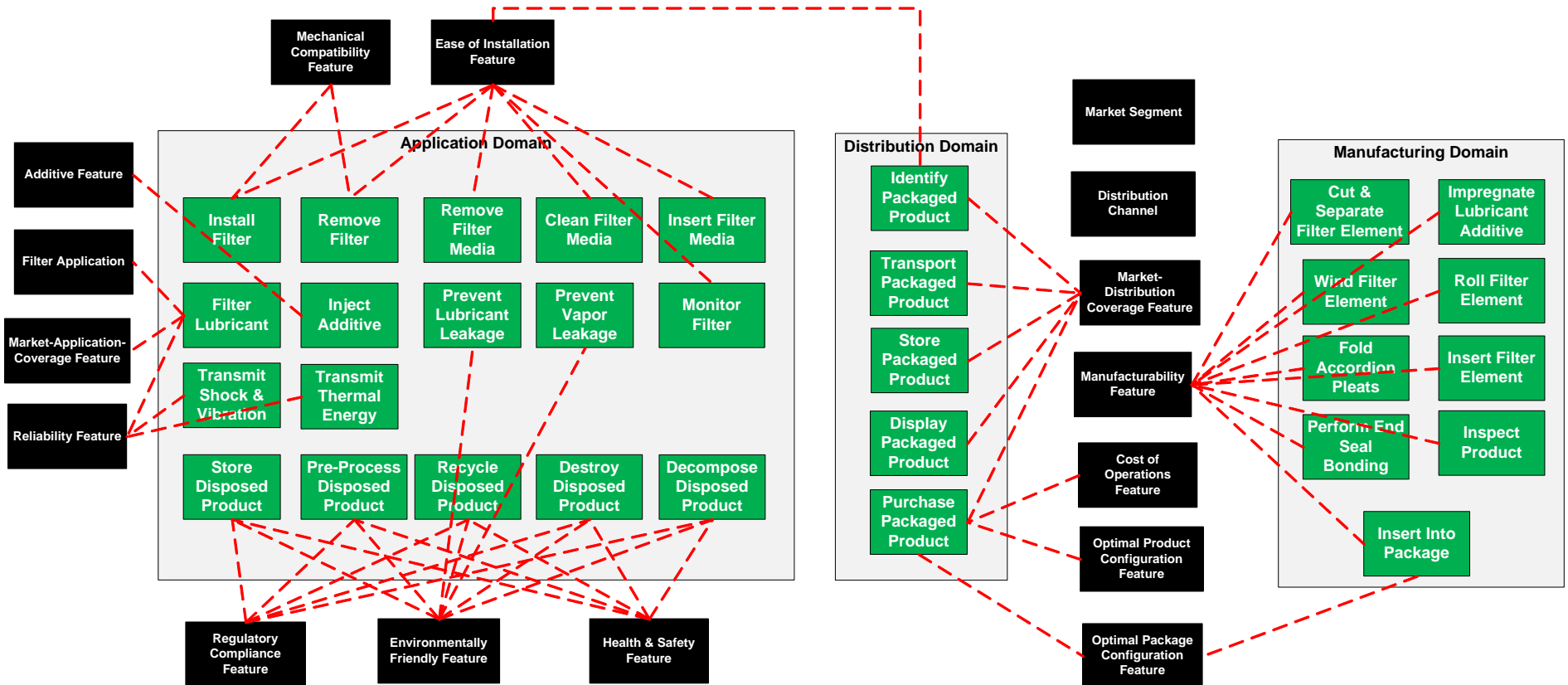
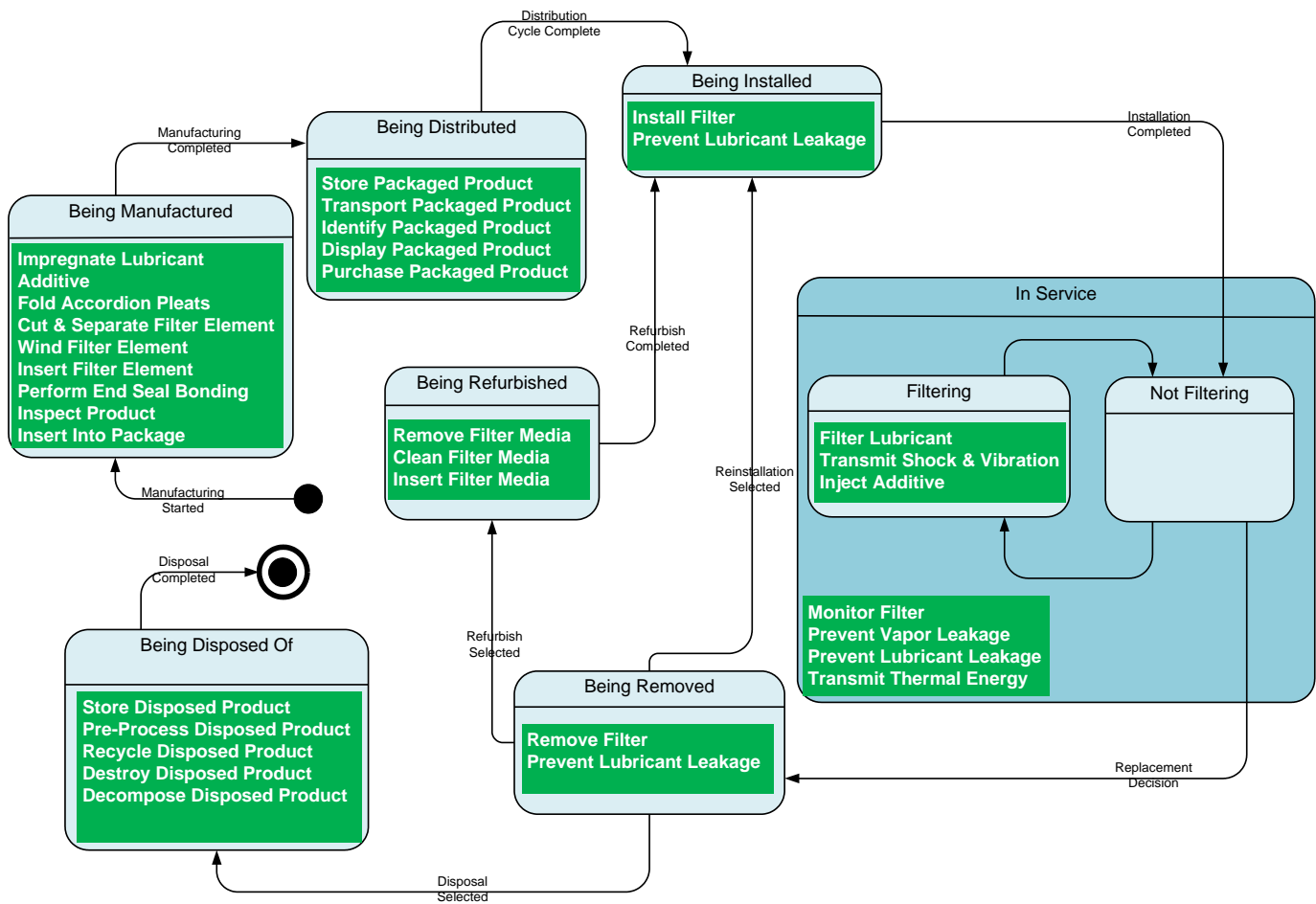


Figure 7: Association of Stakeholder Features and System Interactions

## 2.5 System Life Cycle State (Modes) Model

Figure 8 illustrates the system State Model. Each State is a condition of the system and the environment with which it acts, during which certain external Interactions (from the preceding sections) are expected to occur. These States may be thought of as situations or modes during which certain behavior is expected. The Life Cycle States Model is a summary of these states over the life cycle of an oil filter system.



**Figure 8: System State (Modes) Model**

The Interactions are listed in the interior of each of the above States. The definitions of the States are provided in Table 6 State Definitions.

**Table 6 State Definitions**

State Name	State Definition
In Service	The state during which the oil filter is able to be used.
Filtering	The state during which the oil filter is filtering the lubricant.
Not Filtering	The state during which the oil filter is not filtering the lubricant, but is able to do so.
Being Removed	The state during which the oil filter is being removed from the machine in which it is installed.
Being Refurbished	The state during which the oil filter is being refurbished in order to be used again.



State Name	State Definition
Being Installed	The state during which the oil filter is being installed in the machine in which it will serve.
Being Stored	The state during which the oil filter is being stored after being manufactured.
Being Transported	The state during which the oil filter is being transported as part of distribution.
Being Identified	The state during which the identity (type and/or instance) of the oil filter is being recognized.
Being Displayed	The state during which the oil filter is being displayed for sale or use selection.
Being Purchased	The state during which the oil filter is being purchased.
Being Stored after Removal	The state during which a used oil filter is being stored after being removed from service.
Being Pre-Processed	The state during which a used oil filter is being pre-processed for disposal.
Being Recycled	The state during which a used oil filter is being recycled.
Being Decomposed	The state during which a used oil filter is being decomposed.
Being Destroyed	The state during which a used oil filter is being destroyed.

### 3. System Detail Requirements Framework

The Requirements Statements for the Oil Filter System describe the physical behaviors it must exhibit during its physical Interactions with external systems. Table 7 below lists the Requirements Statements allocated to the Oil Filter System during the Interactions listed there.

**Table 7: Detail Requirements**

Interaction	Role	ID	Requirement Statement
Filter Lubricant	Oil Filter System	OF-50	For a Return Lubricant stream of [Lubricant Viscosity Range] and [Lubricant Pressure Range], the Oil Filter shall separate Filtered Contaminant particles from the Lubricant output stream, according to the [Filter Particle Size Distribution Profile].
Filter Lubricant	Oil Filter System	OF-51	The Oil Filter shall operate at lubricant pressure of [Max Lubricant Pressure] with structural failure rates less than [Max Structural Failure Rate] over an in-service life of [Min Service Life].
Filter Lubricant	Oil Filter System	OF-52	The Oil Filter shall accommodate a Lubricant flow rate of [Lubricant Flow Rate].
Filter Lubricant	Lubricant Distribution Pump	OF-53	The Pump shall maintain oil pressure within the [Lubricant Pressure Range].
Filter Lubricant	Lubricant In Filtration	OF-54	The Lubricant in Filtration shall have viscosity within the [Lubricant Viscosity Range].
Filter Lubricant	Lubricated Machine	OF-55	The Lubricated Machine shall contribute a Contaminant Load to the lubricant, not to exceed [Lubricant Contaminant Load Rate].
Filter Lubricant	Lubricated Machine	OF-56	The Lubricated Machine shall not heat the lubricant above [Max Lubricant Temperature].
Inject Additive	Oil Filter System	OF-57	The Oil Filter shall inject additive of type [Additive Type] into the Lubricant flow, at a rate of [Additive Injection Rate] per unit of lubricant flow, over the service life of the filter element.
Remove Filter Media	Oil Filter System	OF-90	The Oil Filter System shall permit the removal of its used Filter Media.
Remove Filter Media	Oil Filter System	OF-91	The Oil Filter System filter media removal process shall allow the service person to avoid direct contact contamination with filtered contaminants and lubricant.
Clean Filter Media	Oil Filter System	OF-92	The Oil Filter System shall permit the cleaning of its used Filter Media, for reuse purposes, using cleaning solvent and method of type [Filter Media Cleaning Method and Solvent].
Clean Filter Media	Oil Filter System	OF-93	The Oil Filter System filter cleaning process shall allow the service person to avoid direct contact contamination with filtered contaminants and lubricant.
Insert Filter Media	Oil Filter System	OF-94	The Oil Filter System shall permit the insertion of its Filter Media, of type [Filter Media Type].
Insert Filter Media	Oil Filter System	OF-95	The Oil Filter System filter media insertion process shall allow the service person to avoid direct contact contamination with filtered contaminants and lubricant.
Transmit Shock & Vibration	Oil Filter System	OF-100	The system shall meet its other requirements when subject to a vibration spectrum not exceeding [Max Vibration Spectrum] during its in-service life.
Transmit Shock & Vibration	Oil Filter System	OF-101	The system shall meet its other requirements when subject to shock intensity and frequency not exceeding [Max Shock Intensity and Frequency] during its in-service life.

<b>Interaction</b>	<b>Role</b>	<b>ID</b>	<b>Requirement Statement</b>
Monitor Filter	Oil Filter System	OF-102	The system shall provide a means of inspection of its remaining service life before requiring servicing, using [Filter Monitoring Method].
Prevent Vapor Leakage	Oil Filter System	OF-103	When operating within its rated lubricant pressure and temperature, at altitudes not exceeding [Max Service Altitude], the system shall maintain Vapor Leakage to the ambient air space below [Max Vapor Leakage Rate].
Prevent Lubricant Leakage	Oil Filter System	OF-104	When operating within its rated lubricant pressure and temperature, at altitudes not exceeding [Max Service Altitude], the system shall maintain Fluid Leakage to the surrounding space below [Max Fluid Leakage Rate].
Transmit Thermal Energy	Oil Filter System	OF-105	The system shall meet its other requirements while operating in external ambient air temperatures of [External Temperature Range] and lubricant temperatures of [Lubricant Temperature Range].
Install Filter	Oil Filter System	OF-106	The Oil Filter shall be manually installable in ten minutes or less, using only a screwdriver.
Install Filter	Oil Filter System	OF-107	The Oil Filter shall have installation instructions printed on its exterior surface, in [National Language] language.
Install Filter	Oil Filter System	OF-110	The Oil Filter shall not present sharp edge hazards to the installer during the installation process.
Install Filter	Oil Filter System	OF-111	The Oil Filter shall be clearly labeled with instructions to shut down pressurized equipment prior to installation.
Install Filter	Service Person	OF-112	The Service Person with the visual acuity and hand strength of an average 40 year old adult shall be able to install the Oil Filter System.
Install Filter	Service Person	OF-113	The Service Person shall be capable of reading [National Language] at the tenth grade level.
Remove Filter	Oil Filter System	OF-114	The Oil Filter shall be manually de-installable in five minutes or less, using only a screwdriver.
Remove Filter	Oil Filter System	OF-115	The Oil Filter shall be clearly labeled with instructions to shut down pressurized equipment prior to de-installation.
Remove Filter	Oil Filter System	OF-116	The Oil Filter shall not present sharp edge hazards to the installer during the de-installation process.
Store Disposed Product	Oil Filter System	OF-137	The Oil Filter System shall have instructions printed on its surface in [National Language] describing instructions for its after-removal storage.
Store Disposed Product	Oil Filter System	OF-138	The Oil Filter shall not present sharp edge hazards to personnel during insertion into storage, or subsequent storage.
Pre-Process Disposed Product	Oil Filter System	OF-139	The Oil Filter System shall have instructions printed on its surface in [National Language] describing instructions for its after-removal disposal pre-processing.
Pre-Process Disposed Product	Oil Filter System	OF-140	The Oil Filter shall not present sharp edge hazards to personnel during disposal pre-processing.
Recycle Disposed Product	Oil Filter System	OF-141	The Oil Filter System shall have instructions printed on its surface in [National Language] describing instructions for its after-removal disposal recycling.
Recycle Disposed Product	Oil Filter System	OF-142	The Oil Filter shall not present sharp edge hazards to personnel during recycling.
Destroy Disposed Product	Oil Filter System	OF-143	After normal in-service use, when subject to incineration temperature of [Incineration Temperature] for a period not more than [Incineration Time], the system shall be reduced to [Incineration Solid Product Profile] and [Incineration Gaseous Product Profile].