

Value Characterization across the Product Lifecycle to Support Green PLM and Business Creation

PLM Center of Excellence

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Outline

. Introduction

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III. VPLC Model

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- > Decision-making

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- IV. Timeline
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PLM: Technology for computer-based product development and information management from product concept to end-of-life GPLM: Evolving concept that considers **multi-use lifecycles and** considers **resource consumption** and **waste streams**.



I. Introduction

This is important because it...

- 1. Allows designers to create products that avoid value erosion over time.
- 2. Promotes the design of products with multiple use lifecycles.
- 3. Anticipates and fosters the creation of new business opportunities.



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II. VALUE

Value is an attribute of a product or service. Customers pay for value. Design and manufacturing create value. Generally, when a customer uses the product or service, value is consumed. In a enterprise, different sources might contribute to generate the total value of the system.





III. Value Product Lifecycle (VPLC) Model System Dynamics

A system is a set of interrelated elements, where any change in any element affects the set as a whole (<u>Bertalanffy, 1969</u>). Systems thinking has its foundation in the field of system dynamics (<u>Forrester, 1961</u>). System Dynamics (SD) studies how a system **changes over time**, the **interaction** between its elements, and how to improve the overall **system performance** (<u>Sterman, 2000</u>).



III. VPLC Model Purpose



The model for Value across Product Lifecycle (VPLC) will describe the change of product value over time (production through recovery and capitalize on secondary markets).

The VPLC will analyze the impact of **maintenance**, **remanufacturing**, **and recycling** in the creation of the economic value for the business under study.



Overall business (system) value





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III. VPLC Model Decision-making

1. How the total value generated by the system changes when an end-of-use (EOU) recovery policy is considered?

2. What conditions provide the highest value for the system: open or closed remanufacturing? open or closed recycling?

3. What is the long term impact of maintenance on reliability and the EOU state of the product?

4. How the value generated at EOU varies with remanufacturing and recycling rates?

5. What is the long term impact of technology obsolescence on the value generated at EOU?









VPLC MODEL Value across Product Lifecycle

Systems Thinking for Business



III. VPLC general model

The general model includes the **material flow** from product manufacturing, collection at end-of-use (EOU), remanufacturing, recycling, and disposal.





2. Formulation

III. VPLC : maintenance





The maintenance model includes the effect **preventive and corrective maintenance** over the reliability of products at EOU and effect on remanufacturing as an alternative for recovering.



III. VPLC : Total Value Creation



The Total Value Model includes the effect of remanufacturing and recycling on the **total supply chain profit**. In other words, the total value generated in the system.





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IV. Value & wind turbines Estimation of parameters - Demand



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IV. Value & wind turbines Estimation of parameters – used WTs



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IV. Value & wind turbines Estimation of parameters - Operation



IV. Value & wind turbines Estimation of parameters - Remanufacturing



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IV. Value & wind turbines Secondary Market - Remanufacturing

Used WTs Wind farm		T T	T
		Reman WT (V44)	New WT (E48)
₩	Rated Power (kW)	600	600
Remanufacturing	Operational life (yrs)	15	20
Schools Communities	AEP (kWh/yr)	~ 683,709	~ 697,214
	Warranty (yrs)	2	2
	Installed Cost (US\$)*	718,558 (~50-60% original cost)	1,200,000 (~ \$2,000/kW)
Small business	(Sources: NREL, DOL, DESIR foundation, transportation, costs	E) the installed cost includes assembly, grid connection, o	: remanufacturing, and engineering

1 medium size WT could supply energy for 50 homes or 1 school



IV. Value & wind turbines Secondary Market-Recycling





V. Timeline



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VI. Summary



How the value of a product change over time

Effect of Maintenance, Remanufacturing, and Recycling on value at EOU

4 sub-models: General, Maintenance, Satisfaction, and Total value Methodology

System Dynamics to analyze changes over time

4 Phases: conceptualization, formulation, testing, implementations

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Emerging technology, fast growth, capital intensive, and high potential of value recovery

Business opportunities:
Remanufacturing of
whole system,
components, and
critical materials.



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