



A Systems Engineering Approach to Cannabis Product Development

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What Do We Mean by Cannabis Products?

- It's not just “bud” anymore





What is Systems Engineering?

- **Systems Engineering** focuses on ensuring the pieces work together to achieve the objectives of the whole
- **Systems Engineering** works to optimize the elements of an interdependent, interconnected, complex system, understanding the system ripple effects, to achieve the stakeholder requirements
- **Systems Engineers** are the technical conscience of a Project
 - They are the influencers to ensure that the risks and potential problems are addressed and mitigated



Where Does Cannabis Product Development Fit in Systems Engineering?

The role of Systems Engineering in Cannabis Product Development is evolving as the systems become more complex

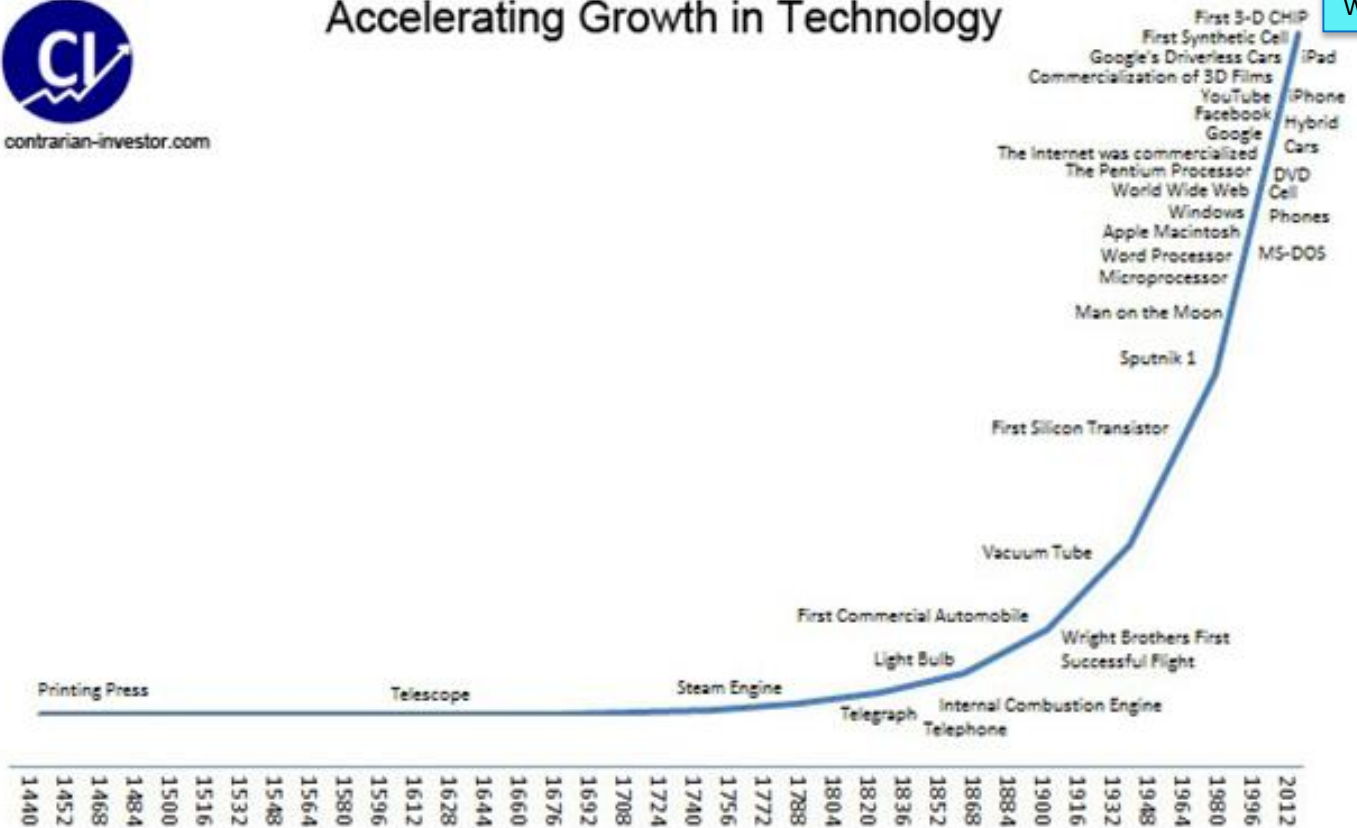




Growth in Complexity is Increasing



Accelerating Growth in Technology



Systems Engineering is critical in complex, interdependent, and interconnected systems



A Systems Engineering Perspective is Needed to Design New Cannabis Products

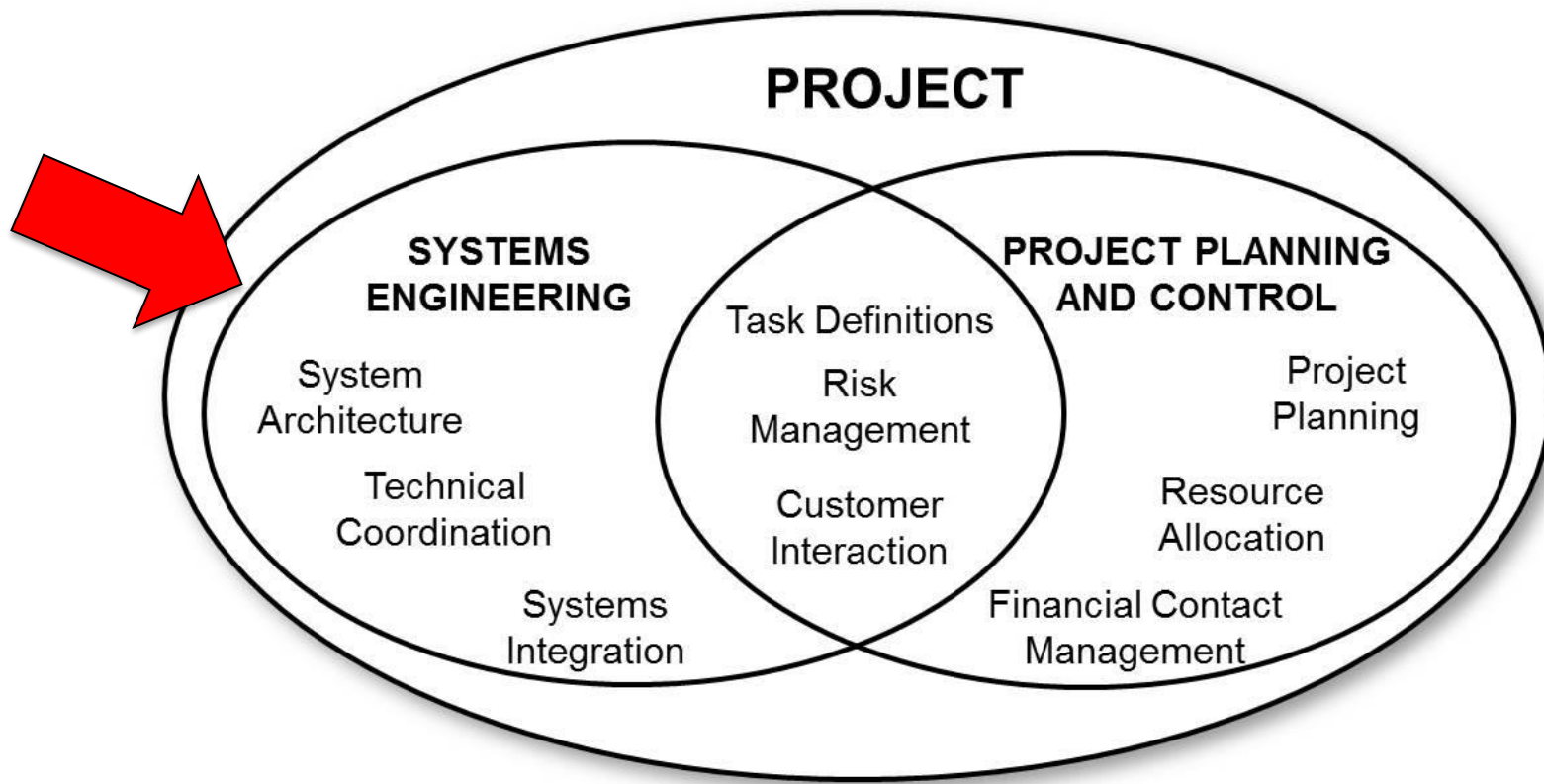


Figure 5-1 SE/Project Planning and Control Overlap

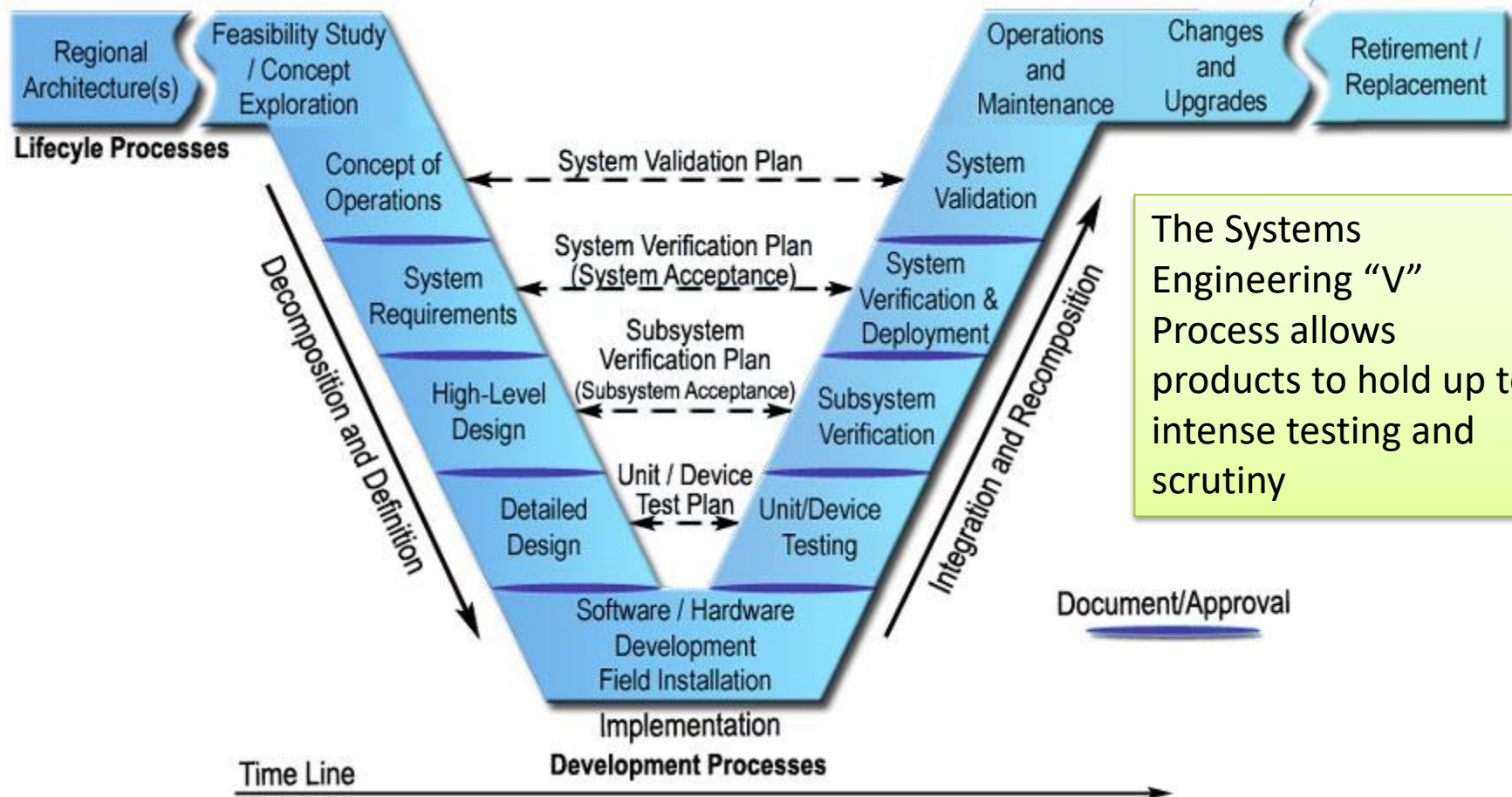
From Kossiakoff and Sweet (2003). Systems Engineering: Principles and Practice Page 91



A Process-driven Approach

- “Process” is an approach to solving difficult engineering and development problems
 - It uses systematic steps that are followed to put together a final product
 - There is a “roadmap” and orderly progression of review and decision-making leading to a product that meets the requirements
- Systems Engineering is collaborative and concurrent; team members work together tightly
 - A Systems Engineer is the natural leader, but does so collaboratively
- By focusing on Process, we can reduce the risks posed to producing the right product – making safe, tested, and high quality cannabis products

The Systems Engineering Process





Why Implement Systems Engineering in Cannabis Product Development?

Reliability, Safety, Quality

- **The Systems Engineer is**
 - Independent Technical Authority (ITA)
 - Does not work for the Project Manager
 - Calls out issues when others cannot / will not
 - Calls for reviews to ensure that the entire system of activities is optimized for quality and safety
 - ***The technical conscience of the development***

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Enhanced Quality Assurance

- **Good Systems Engineering practices aid in**
 - Compliance
 - cGMP
 - ISO
 - GHP/GAP



Prevents Isolation of Teams

- **Barriers in Communication**
 - Prevents individual experts from optimizing their particular areas at the possible expense of the entire system



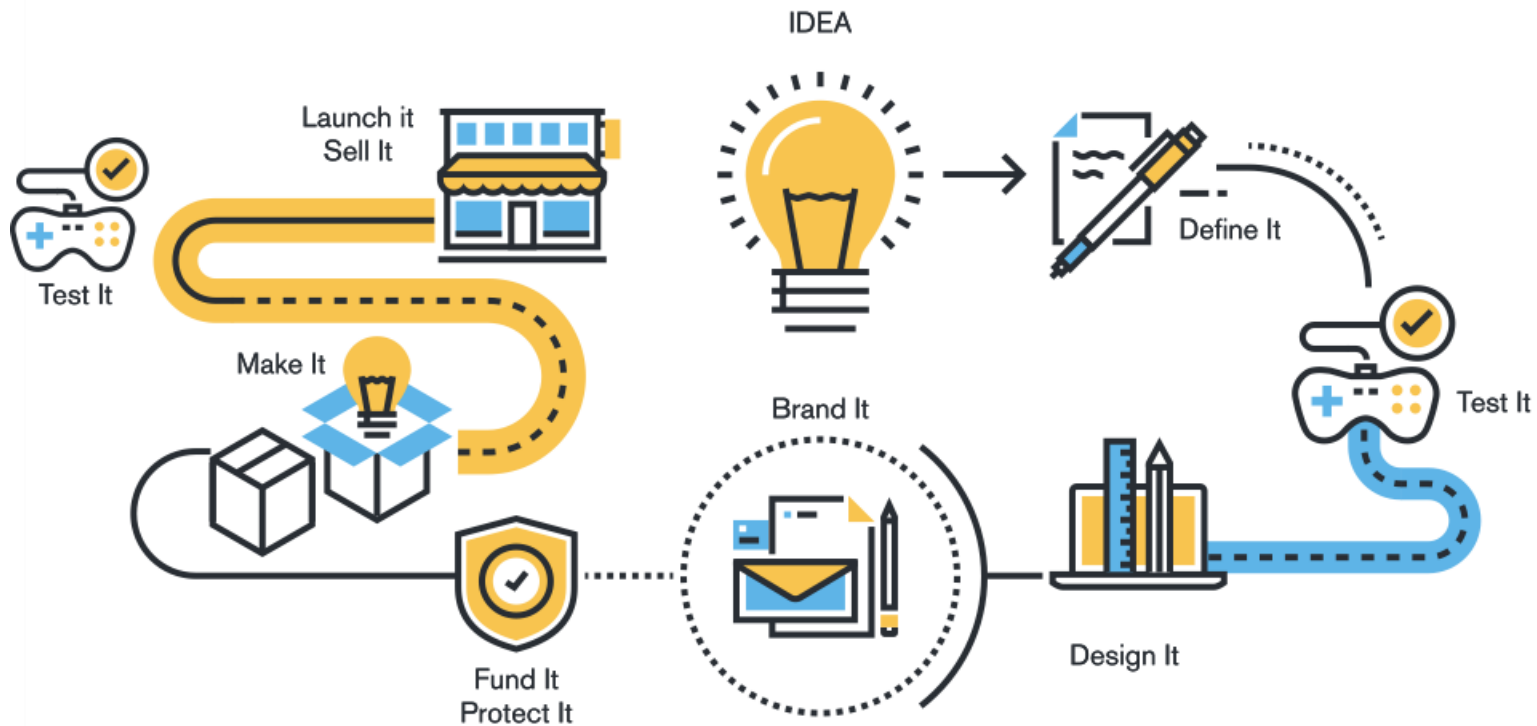
F1 Race Car development is a great example of collaborative engineering and Systems

Better Overall Project Management

- Saves project **budget** in the long run by addressing fixes before they become problems
- Saves **schedule** by optimizing over all of the project elements
- Addresses **risk** by doing the deep dive into the individual technical areas to ensure the technical areas play together well



Active Across the Entire Product Development Process





Cannabis Systems Engineering Toolkit

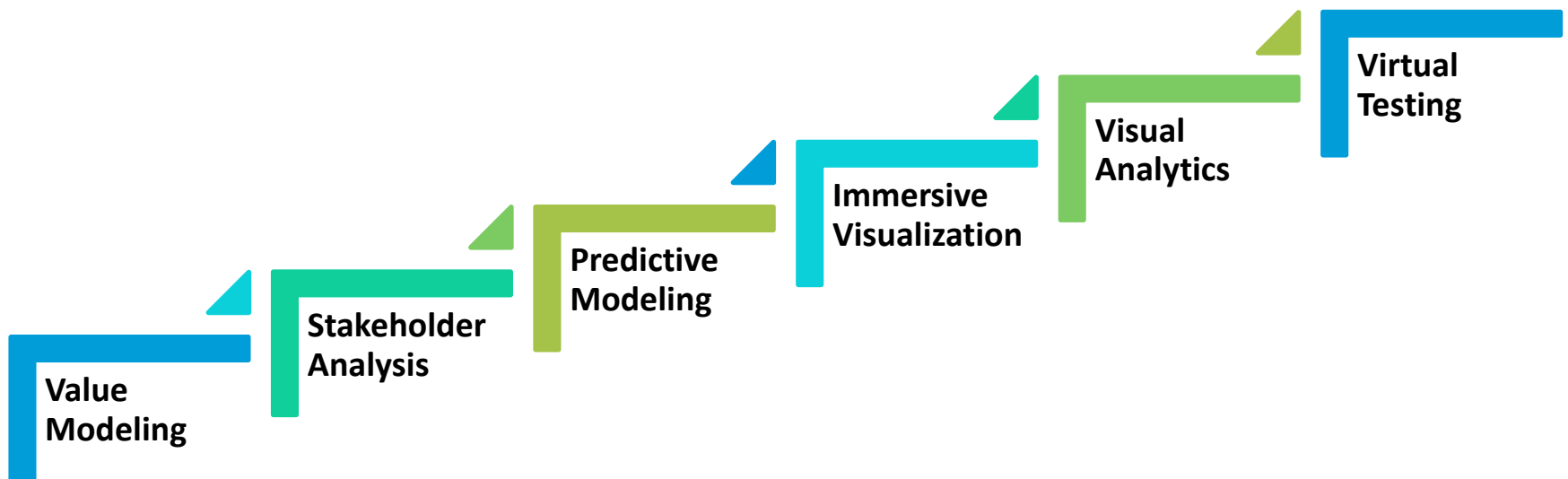
*How Do We
Make This
Happen?*



*It's about
computers
and
modeling!*



Advanced Techniques in the Systems Engineering Toolkit



All advanced techniques rely on the ongoing development of software and use of meaningful case studies to provide reliable and trustworthy results

Value Modeling



Determine the highest value product line of cannabis products for the consumer, based on customer value.

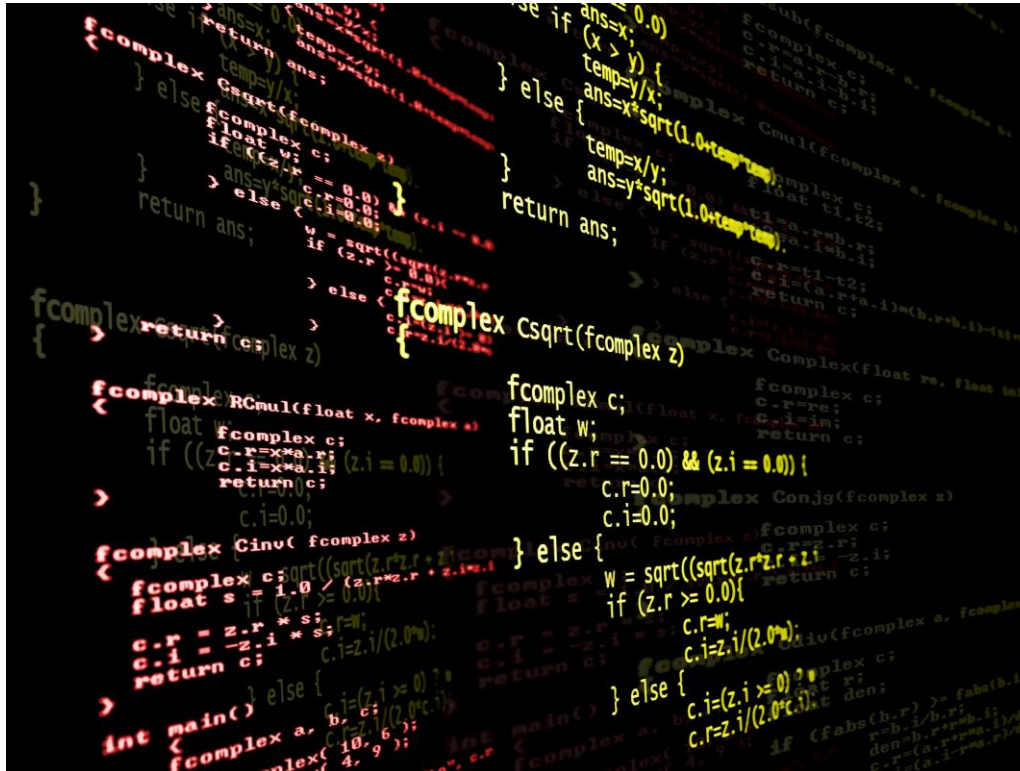
Value = Benefits - Price

Stakeholder Analysis



Stakeholders are people that are in any part of the value chain – consumers, suppliers, and workers. Your goal is to convert stakeholders into advocates.

Predictive Modeling



Predictive modeling uses statistical modeling, which can be parametric, non-parametric, or semi-parametric to assess your opportunity.



Immersive Visualization



We are experiencing a revolution in visualization. It provides insights that we miss without multi-dimensional immersion, aka, virtual reality.

Visual Analytics



This is the science of analytical reasoning facilitated by interactive visual interfaces. It is a partnership of computer science and human factors.



Virtual Testing



Use of physiological models for virtual testing of new cannabis products is a revolutionary new technique, using a variety of software tools to build the appropriate viable systems. This is the right place to develop and exploit Model-Based Systems Engineering.



How Do We Enable Systems Engineering for Cannabis Product Development?

- ✓ Move from “spreadsheets” to active software systems and AI
- ✓ Invest in Continuous Training of Workforce
- ✓ Provide meaningful Testbed cases for Advanced Techniques (Case studies)
- ✓ Implement Model-Based Systems Engineering (MBSE) for physiological systems

Serious Cannabis Companies Need to Invest in Developing Advanced Systems Engineering Tools



Next Steps for Systems Engineering For Cannabis Product Development

1. Start with a strong set of Requirements for the Cannabis Product – plan for verification and validation
2. Conduct Value Modeling and Stakeholder Analysis to determine the right products for the right customer
3. Initiate Predictive Modeling to prepare realistic expectations for product valuation and profit
4. Develop Immersive Visualization and Visual Analytics to support engineers and developers in efficient cannabis product development
5. Initiate Virtual Testing with physiological models and Model-Based Systems Engineering to promote quality
6. Implement the Advanced **Cannabis Systems Engineering Toolkit** to ensure safety of cannabis products for the consumers of today and tomorrow!





Questions?

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to Cannabis Product Development

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