An Introduction to Engineering

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The Art of Engineering

- The Art and Science of Change
  - Creation of New Devices
  - Creation of New Processes
  - Creation of Intellectual Property
  - Improvement of Existing Design
  - Improvement of Existing Process

Summary

- Understand what we will be expected to do in our jobs
- Understand what we can do to improve our ability to perform our jobs
- Understand what success in engineering is all about

How does education work?

- Undergraduate
  - We learn that we can learn
  - We learn how to specific tasks
  - We learn how to get the right answer
  - We note that issues are very black and white in most curriculum

How does education work?

- Masters Level
  - We learn that there are multiple right answers
  - We learn to do nebulous or ambiguous work
  - We learn that it is up to us to make the call based upon our education and experience
  - We learn there are shades of gray to every issue

How does education work?

- Doctoral Level
  - We learn that we must find answers that may or may not be right
  - We must be able to defend our decisions and work
  - We learn that no one else may have a right answer either
  - We learn that ambiguous work is the norm
  - We learn that there are many colors to each issue

Entering the work force

- We discover that the same structure is present in society
  - We begin work undertaking specific tasks in order to get the right answer
  - After a few years, we find that our work becomes more ambiguous and complex
  - After more years, we find survival amongst ambiguity to be highly valued in the organization

Therefore, we must continue to develop our abilities

- Relying on our technical competence at first
- Then beginning to develop organizational skills
- Increasing our ability to handle ambiguity
  - Project Management Skills
  - Personnel Management Skills

Resulting in a more balanced education

- Technical Skills
- Project Management Skills
- Human Behavior Skills
  - Predicting personal behaviors to get things accomplished
  - Influencing outcomes
  - Understanding psychology, sociology, organizational culture, politics, organizational design, job design, individual differences and job satisfaction

Engineers: What do we do?

- Engineering Design Work - New Ideas
- Project Management
  - Planning/Scheduling
  - Controlling
- Drink Coffee
- Complain About Management

Engineering Tasks

- All Engineers Essentially Work in a Project Environment
- Typical Engineers Work on 3-7 Projects Simultaneously
- Many Engineers Work at Varying Levels of Responsibility across Projects
- Therefore Project Management is a Critical Skill for Engineers

Engineering Project Management

To Best Apply Company Assets

Within Time, Cost and Product Requirement Constraints

What is Project Management?

- The Ability to Maintain a Desired Effect in the Midst of a Variable Environment
- Utilizing the Company Assets at Your Disposal for Maximum Corporate Benefit

Company Assets

- Personnel
- Investment
- Ideas/ Intellectual Property
- Asset Enhancement
  - Maximizing the Amount of Potential Opportunity
  - Minimizing the Amount of Potential Risks

Engineering Project Management

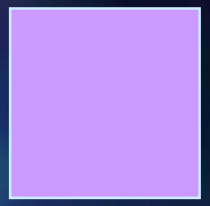
- The Milestones of Management
  - Understanding Yourself
  - Understanding Your People
  - Understanding Your Environment

Understanding Yourself

The Triangle

- 2nd most popular choice
- Analytical
  - Oriented toward problem solving
  - Not oriented to fire-prevention
  - Tend to accept other peoples monkeys
  - Task oriented
  - Not good in dealing with people

The Square



- 3rd most popular choice
- Disciplined
  - High sense of order, policies, procedures
  - Prefer symmetry and balance
  - Positive force for quality
  - Cautious regarding change
  - Most productive group, detail oriented

The Z

- Least common choice
- Creative
  - Mental Risk Takers
  - Open to change, new, different things
  - Problem paying attention to detail
  - Poor follow-up, Implementation

The Circle

- The most popular choice
- The People People
  - Can be quiet people
  - Good rapport, communications
  - Empathy, caring, respect for others
  - The 'touchy feely' people

Project Management

Understanding Your Environment and People

Management of Projects

The Management of Projects within an organization ultimately comes down to managing the people involved with the projects

Why are People So Important?

- They are the Source of Greatest Variability Within the Organization
- If They So Choose:
  - People Can Make Failing Projects Succeed
  - People Can Make Successful Projects Fail
- Nothing can Overcome the Internal Desire for a Project to Fail
  - You Must Modify the Desire

People Management

- Project Management Would be Much Easier Without the People
- Project Management Would not be Necessary Without the People

Benefits of Using People

- Continuous Improvements
- Creativity
- Versatility
- Intelligence, Learning New Skills
- Low Maintenance, Self Repairing

Liabilities of Using People

- Emotional
- Get Tired
- Limited Load Capacities
- Non-uniform Output
- Extremely Fragile
- Other Interests Besides Job

Project Management

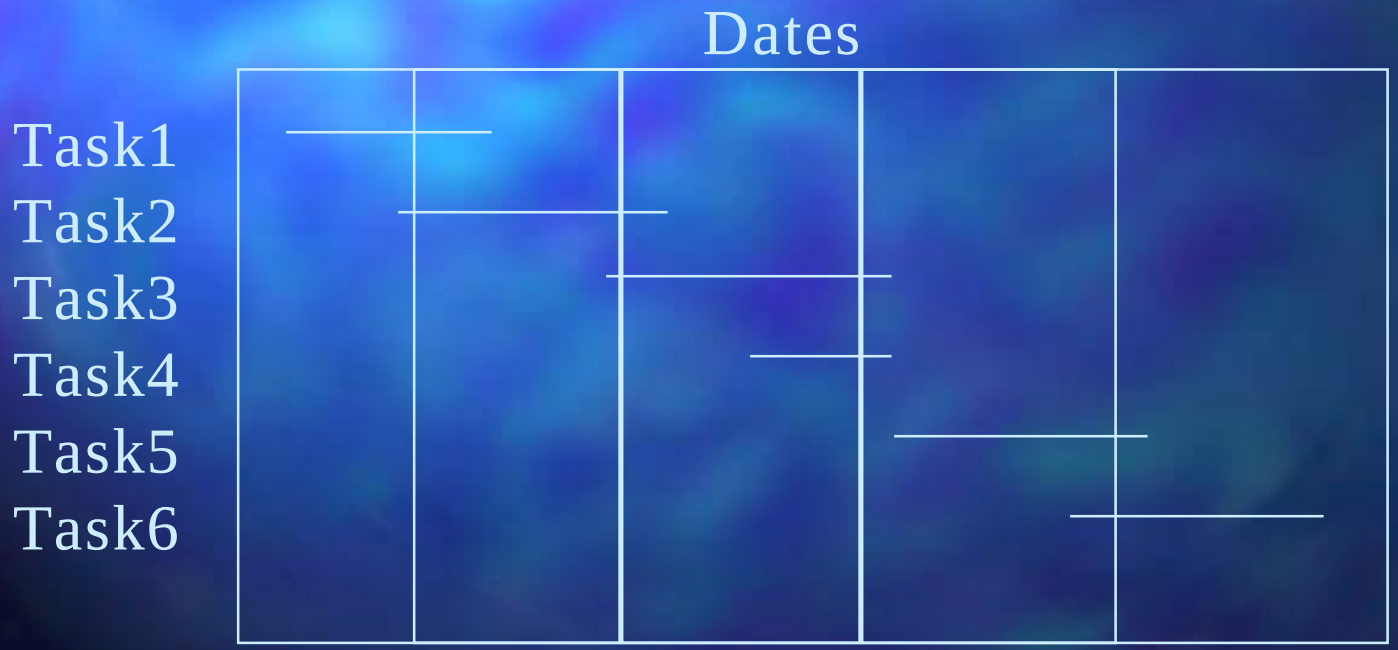
The Ability to Manage the Output of a Known Process with Known Inputs and Well Understood Interrelationships to Create a Desired Effect is Trivial

Project Management

The Ability to Dynamically Manage the Output of a Process with Largely Unknown Inputs and Interrelationships to Create Some Semblance of Desired Effect is Valuable

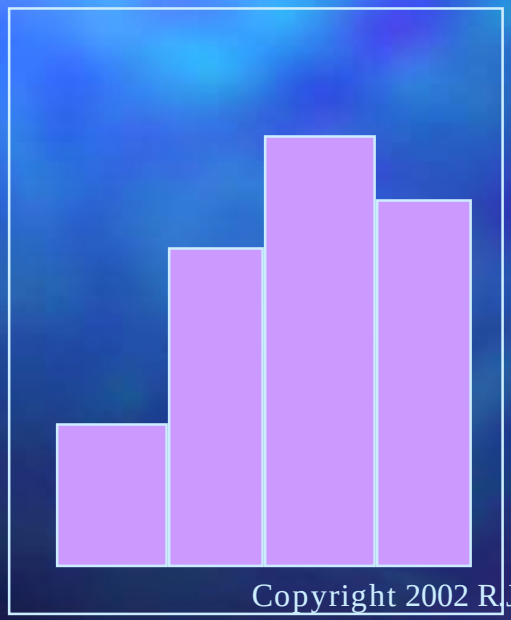
Management of Projects

- Management of Time
  - Accomplished through adherence to a schedule



Management of Projects (continued)

- Management of Investment
  - Accomplished through the use of Budgets/Reports



182736487598
183284674547
857453527345
736465869694
477383595984
473638496043
836354758659

Management of Projects (continued)

- Management of Product Constraints or Performance
  - Accomplished through the use of :
    - Specifications
    - Inter-Department Communications
    - Intra-Department Communications (aka Concurrent Engineering)

Engineering is Information

- Engineers are Generally Paid for Conclusions and Assessments
- These are Based on Information Everyone Has Available
- Engineers Have a Demonstrated Capability to Hypothesize this Data

Engineering is Information

Engineers Are Therefore Well Suited for Technical as Well as Environmental Assessments,

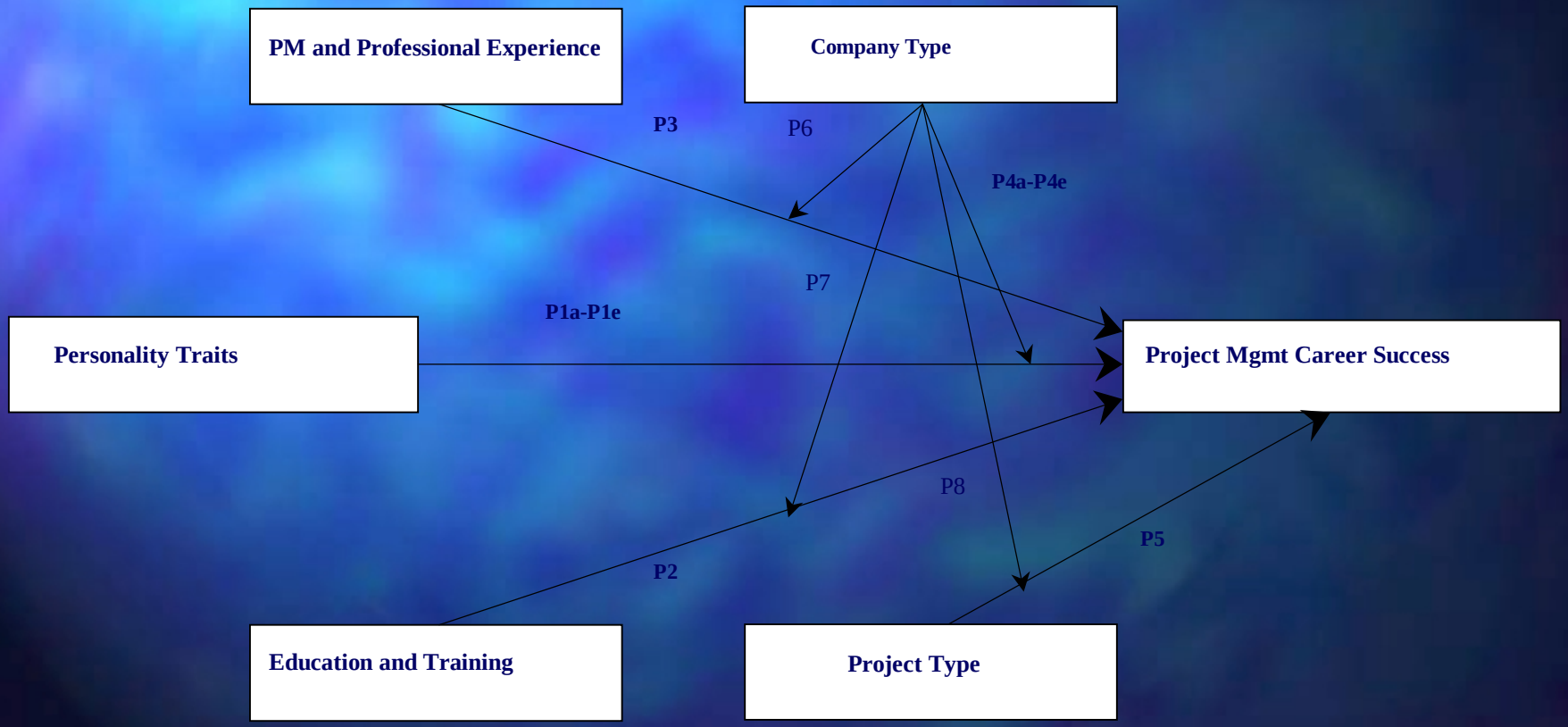
Making Them Ideal Project Managers

Engineering Project Management

- Manage Projects within Time, Cost, and Product Requirement Constraints
- Utilize All Assets at Your Disposal to Fulfill this Mission
  - Knowing Yourself
  - Knowing Your People
  - Knowing Your Environment
- But what defines success in projects?

What is success in Project Management?

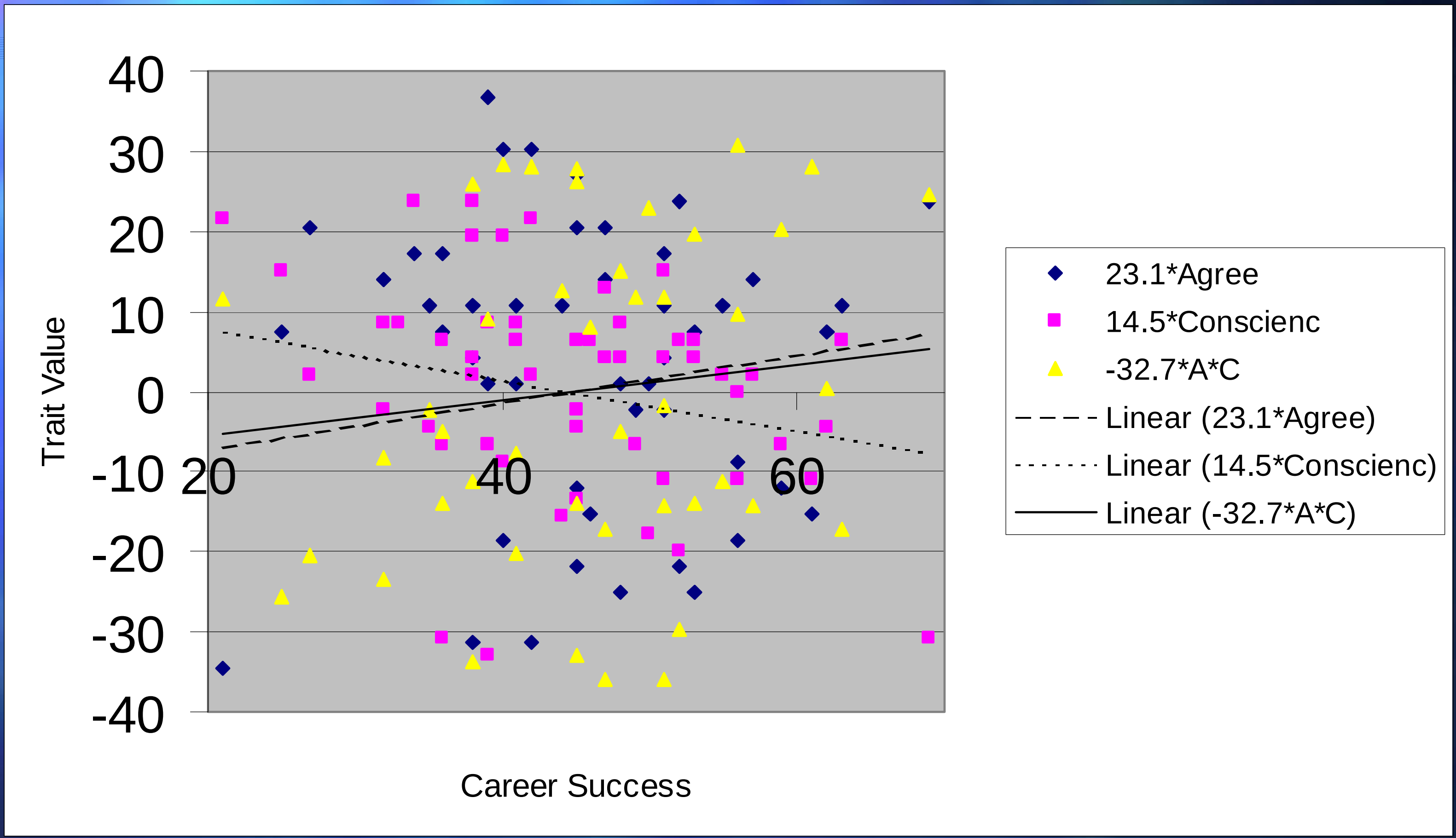
- Consider a model for all projects



Results - General

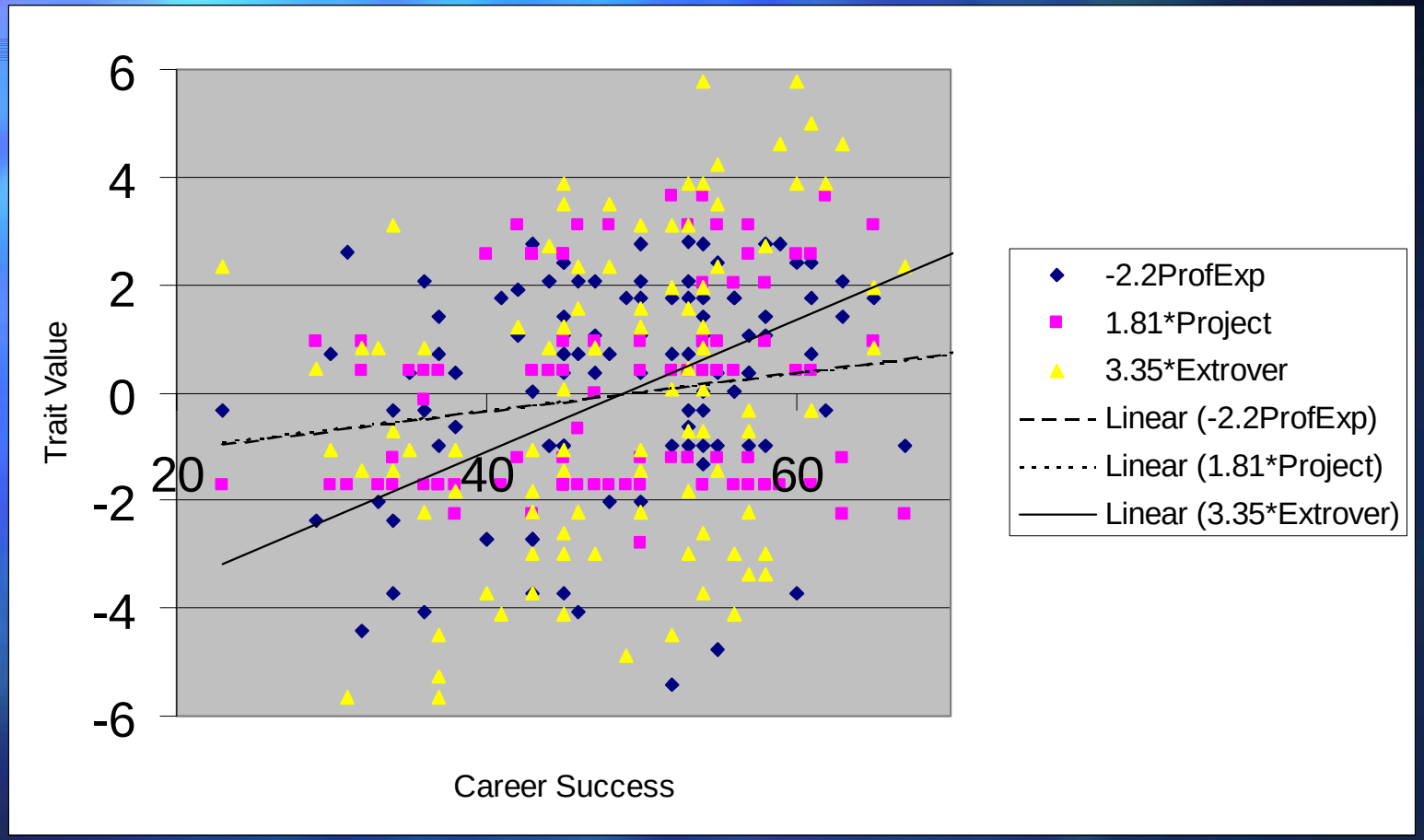
Company Type	Extroversion	Agreeableness	Conscientiousness	Emotional Stability	Openness to Experience	Educ	Prof Exp	PM Exp	Proj Type
Medical		+	+						
Manufact.	-						+		+
Information Systems						+	-	+	
Finance / Service	+			+		+			

Results - Medical



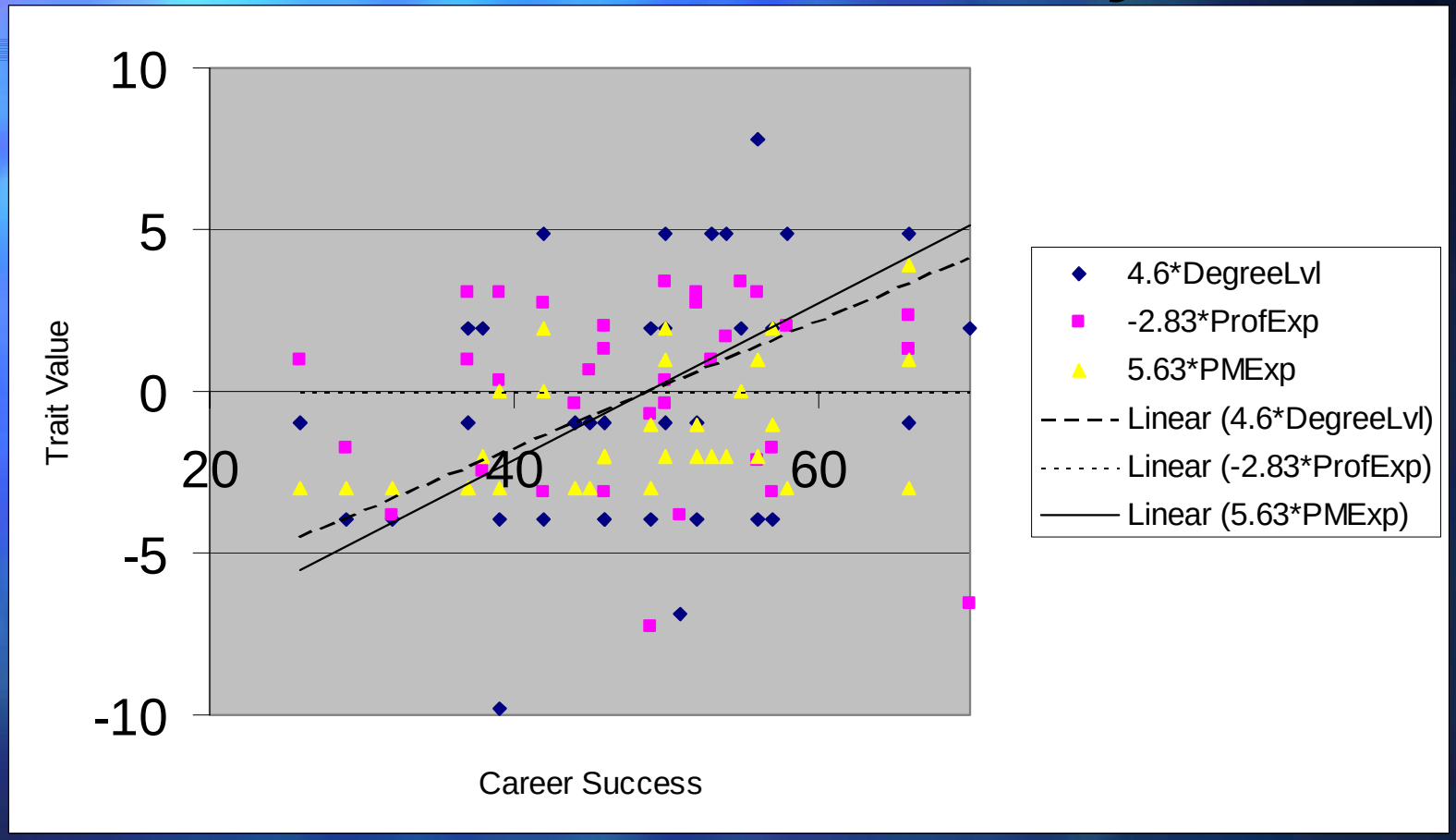
Career Success = 45.6 + 23.1 Agreeableness + 14.5 Conscientiousness - 32.7 Agreeableness * Conscientiousness

Results - Manufacturing



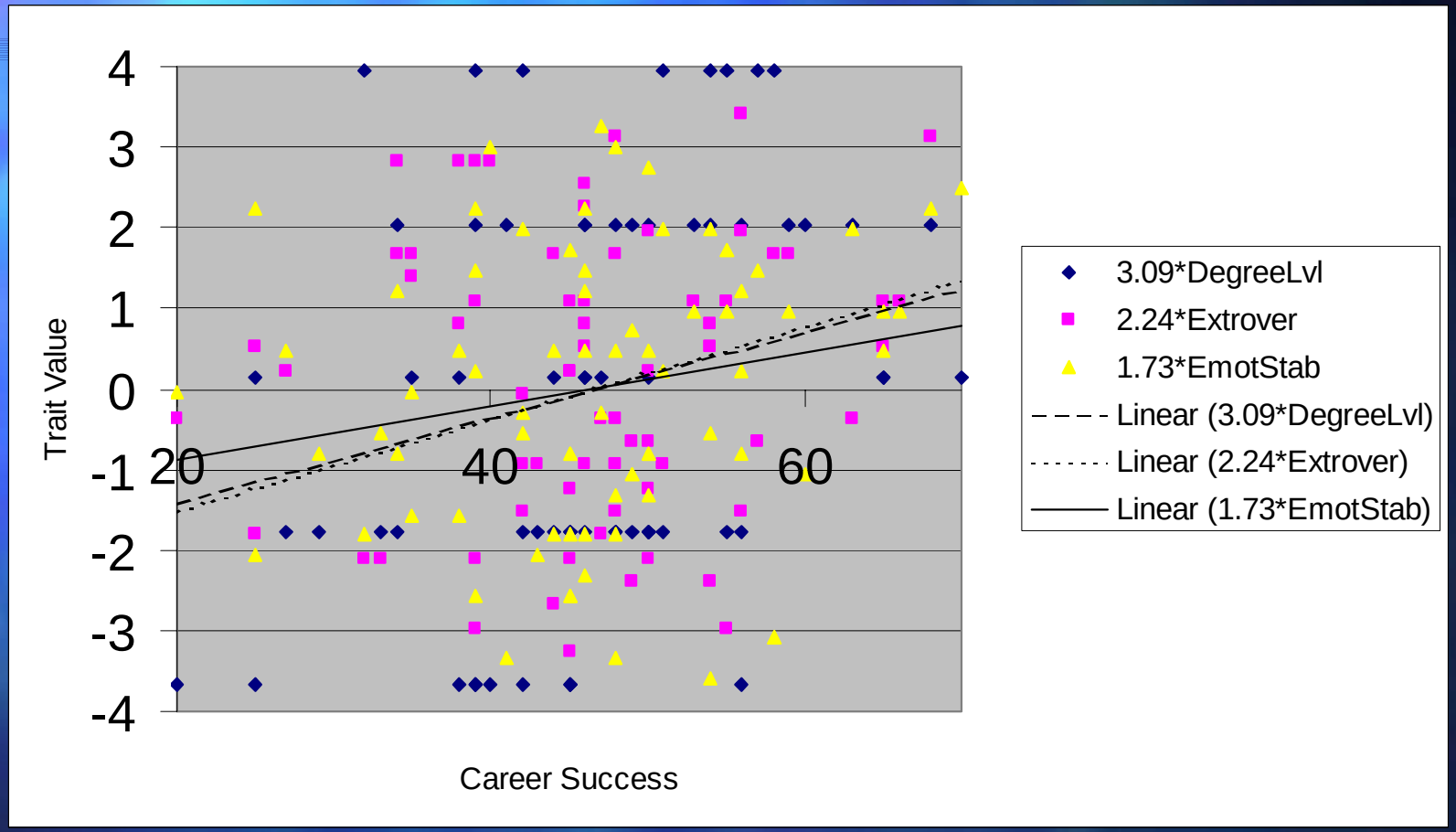
Career Success = 49.5 - 2.20 Professional Experience + 1.81 Project Type + 3.35 Extroversion

Results - Information Systems



Career Success = 48.7 + 4.60 Degree Level - 2.83 Professional Experience + 5.63 PM Experience

Results - Finance / Service



Career Success = 48.3 + 3.09 Degree Level + 2.24 Extroversion + 1.73 Emotional Stability

Discussion - Medical

- Team orientation
  - Requires Agreeableness
- High regulation within the industry
  - Conscientiousness is mandated
- Meyers-Briggs : ESFP, ISFP, ESTJ, ISTJ
- Vocations: Health care, ER Nurse, Medical Assistant, Dental Assistant, Physician, Medical Technician, Clinical Technician

Discussion - Manufacturing

- Widely varying skills/background of colleagues requires Extroversion/Leadership
- Adaptability - Negative with Professional Experience
- Ability to sell others on the project
- Salary compression which diminishes over time
- Meyers-Briggs: ENTJ
- Vocations: Senior Mgr, Office Mgr, Sales Mgr, Franchise Owner, Administrator

Discussion - Information Systems

- Contract employees have many companies, less specific company experience
- Technology infusion rate is high, requiring technical experience and application specific experience
- Short-term actions without long-term results
- Cultural requirement for young and leading edge
- Salary compression similar to manufacturing
- Meyers-Briggs: ESTJ, ISTJ
- Vocations: Programmer, Analyst, Engineer, Administrator, Telecommunications Security, Database Administrator

Discussion - Finance / Service

- Able to adjust to occurrences outside their direct control
- Able to show versatility and stability amid chaotic events
- Meyers-Briggs: ENFP
- Vocations: Artist, Advertising Executive, Strategic Planner, Teacher, Inventor, Consultant, Health Practitioner
  - Individuals who create new solutions to problems

What does this tell us?

- The skills necessary to succeed long term are varied
- We must become adaptable as engineers, and fit our company requirements
- We must develop those areas we are not proficient in, to increase our career success
  - These are typically not technical skills!

Therefore:

- First, utilize your technical skills
- During the first several years focus on organizational skills
- Once mastered, focus on human behavior skills
- It is a never ending journey of self-development and discovery

Summary and Closing

- Understand what we will be expected to do in our jobs
- Understand what we can do to improve our ability to perform our jobs
- Understand what success in engineering is all about