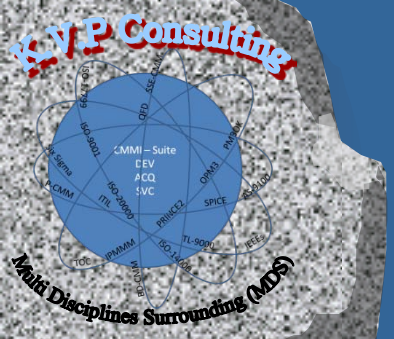
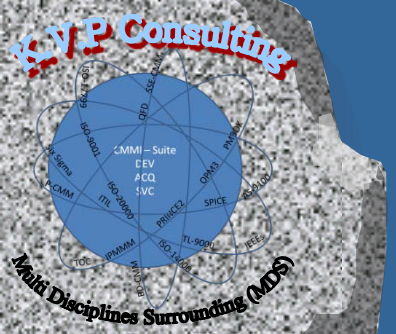


Understanding the Impact of Certain Uncertain Event Using Bayesian Network



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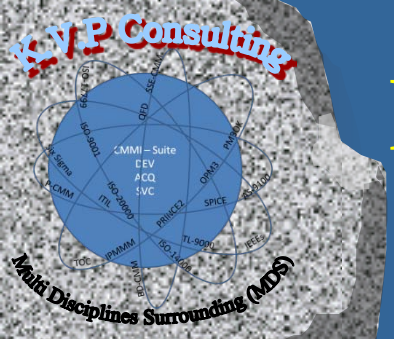


How do we decide when we have little information?

Our focus is on the future – and there are no facts about the future. And not many *facts* about the past!

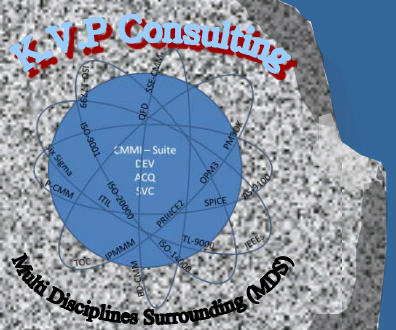
- Decision making ("Decision Analysis"); making "rational" choices

Are you superstitious?

- How are brain works?

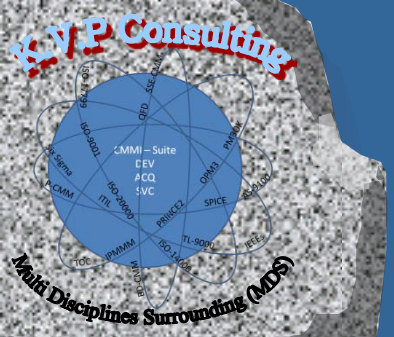
Do you stereotype?

- The patterns of "irrationality"-Rules of Heuristics
  - Cognitive Biases
  - Limited in number??
- Cost/benefit
- Dangers in communication
- Behavior Economics
- How to manipulate others!



What is Heuristics?

- A rule of thumb is an easily learned and easily applied procedure for estimating, recalling some value, or making some determination .
- In decision making, it is generally accepted that heuristics are simple, efficient rules of thumb that help people make decisions or judgments, and help them solve problems .



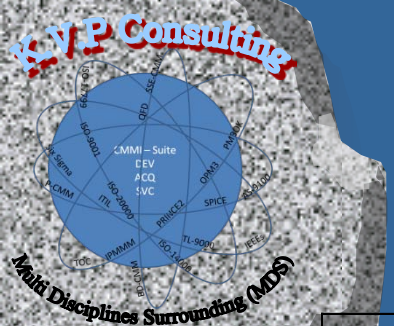
Heuristics, Cont'd

- Heuristics are typically used when decision makers face complex problems or incomplete information, or are short on time .
- In certain situations, however, rules of thumb or heuristics can lead to systematic cognitive biases and less-than-optimal decisions.

Hidden dangers in communication

What do the following phrases mean to you? Please assign a numerical probability to each phrase (using 0-100 percent).

- Possible
- Very likely
- Improbable
- Good chance
- Fair chance



People have different understandings of the same words

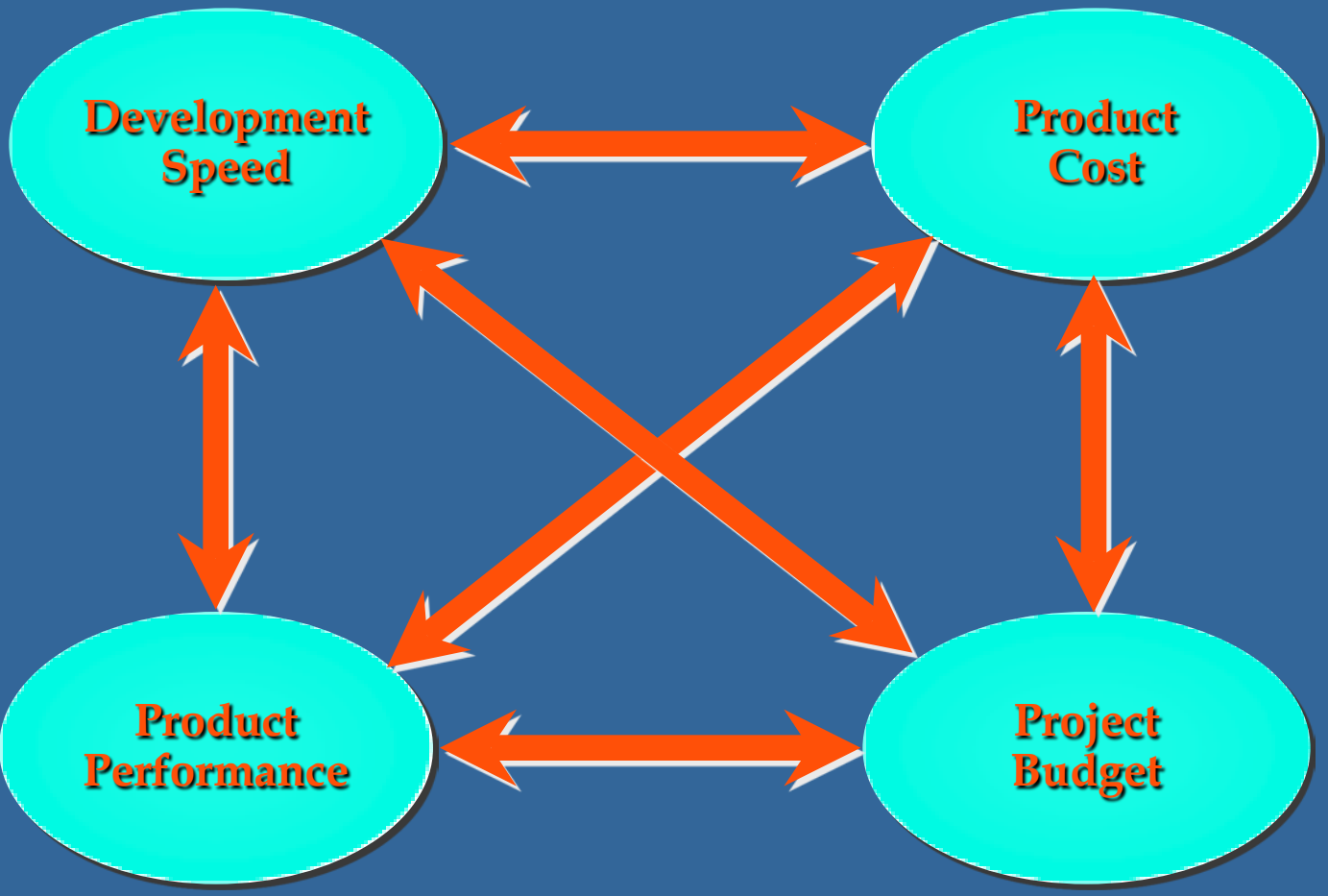
	Min	Mean	Max
Very likely	45	87	99
Good chance	25	74	96
Fair chance	20	51	85
Possible	01	37	99
Improbable	01	12	40

Lichtenstein & Newman, Psychonomic Science, 1967, Vol 9.

(~180 responses per phrase)

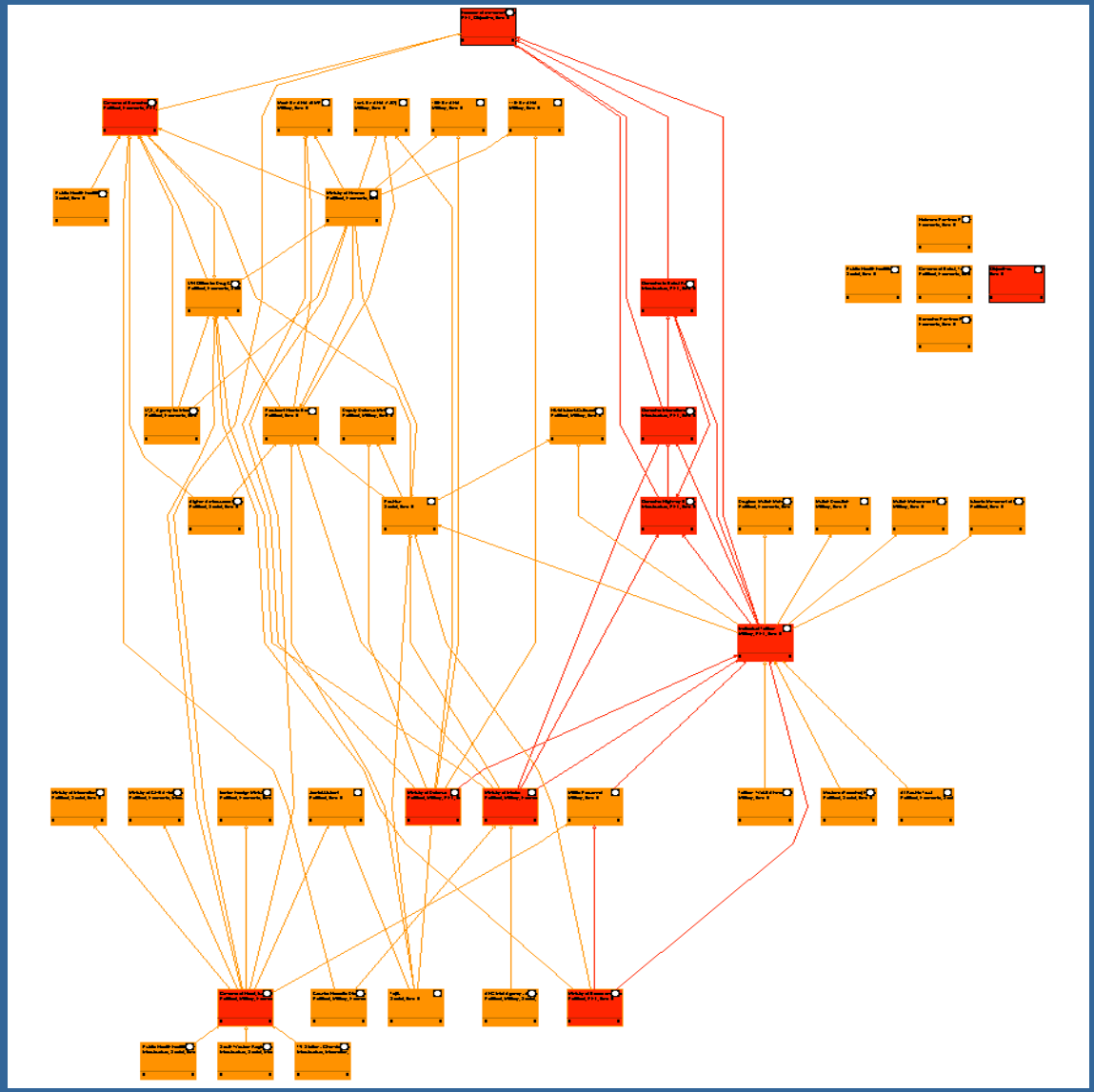

PROGRAMS
COUNTERMEASURES
Non-Lethal Weapons
Nuclear
Chem/Bio Weapons
LO/CLO
Special Access Programs
Personnel Security
Industrial Security
Operations Security
Physical Security
Information Security
Critical Infrastructure
Foreign Disclosure
Electronic/Command & Control Warfare
Information Technology
Information Assurance
Space
Transportation Mgmt
Emanations Security
Supplier Assurance
Anti-Tamper
Example of Safety & Security
Required Standards

The Priority Balance

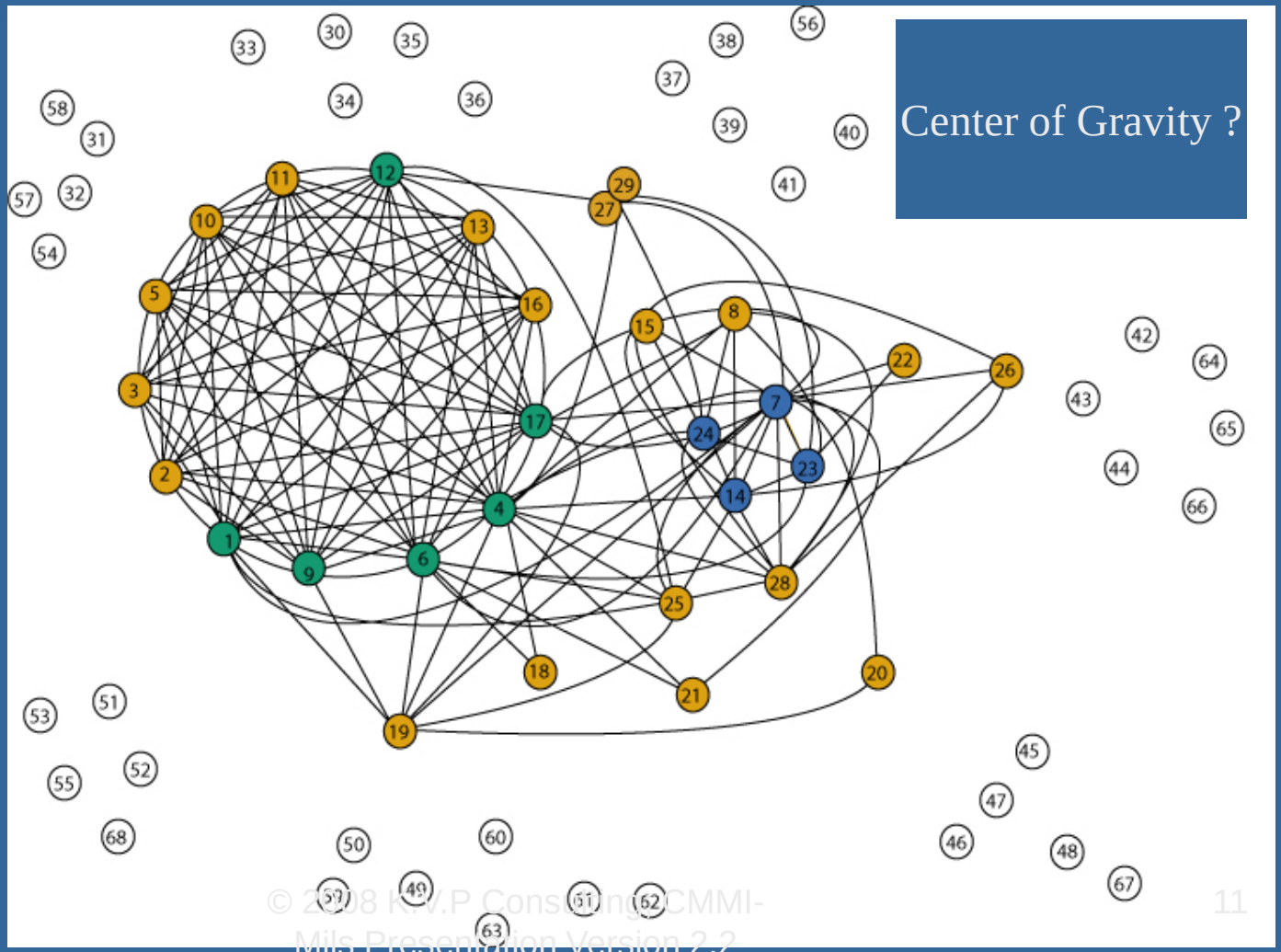


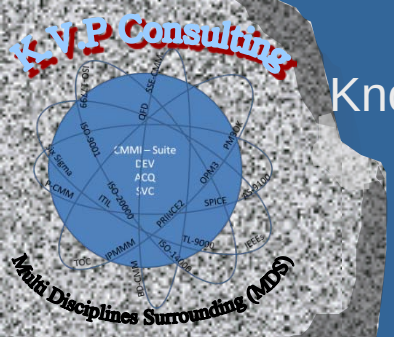
SOURCE: Smith and Reinertsen; Developing Products in Half the Time

A Complex Effects-based Environment



Product Services Support Challenges in the Operational Environment





Known

Unknown

Known
Unknown

Unknown
Unknown

Known
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Unknown
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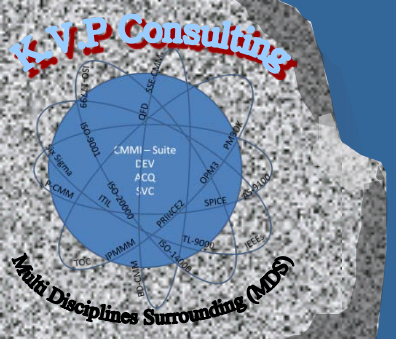
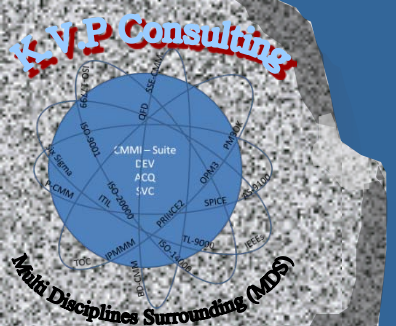
Known

Unknown



Introduction

- Two and a half years ago I Was asked to develop a method that will support the initiation of complicated projects with large number of overlapping stakeholders that influencing the system \ product \ program scope, time and end deliverables.
- The baseline for evaluating what methods will be appropriate we did postmortem and retro- perspective on five programs that ends
- The methods evaluation was conducted at different perspectives (vertical and horizontal) including the use of the following tools: **Game Theory**; **Quality Function Deployment**; **Bayesian Networks and Dynamic Bayesian Games**
- This presentation is a brief summery of the process elements that we were able to identify and the building parameters for its performance measurements
- We will **include** in the presentation (as time will permit it) **tools walk through**; I am willing to share it and send it upon request



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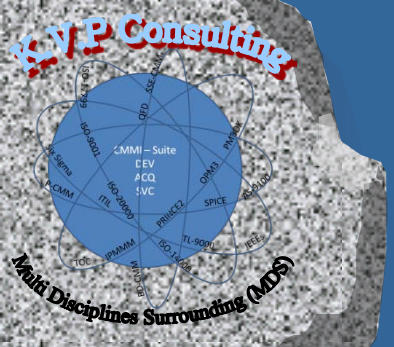
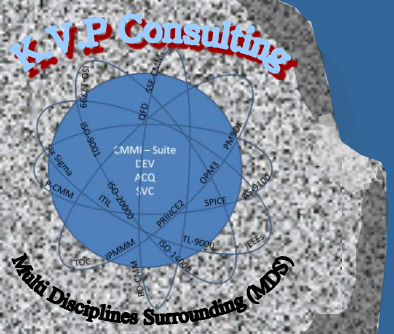
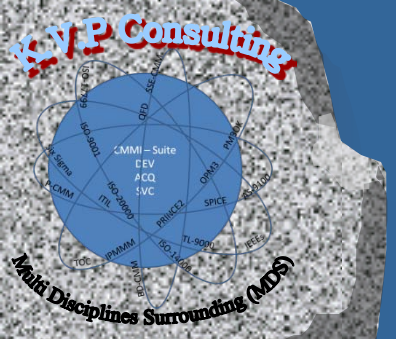

V P Consulting
CMMI – Suite
DEV
ACQ
SVC
Multi Disciplines Surrounding (MDS)

Game Theory



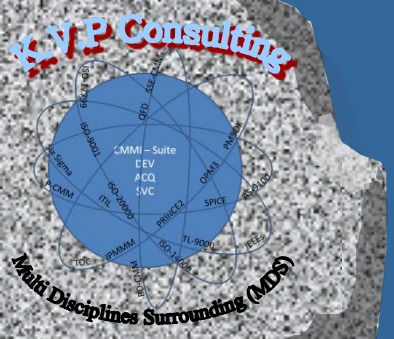
Introducing Example

- You are going to have a blind date in Jena…
- but you don't know where you will meet the other person
- *Only* if you two choose the same location as a meeting point the date will actually take place
- To make it a little easier…
  assume there are only two places to go: „Pizza hut" in Tel Aviv and „Café place" in the Jerusalem
- Where would YOU go?



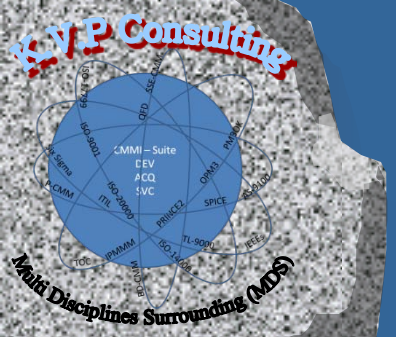
Expected Utility Theory

- Developed by von Neumann & Morgenstern (1947)
- In short: The option with the greatest utility is chosen
- Based on the three assumptions (axioms):
  - Completeness: If there are 2 alternatives, an agent will prefer A or B *or* is indifferent between A and B
  - Transitivity: If an agent prefers A over B *and* B over C, he will also prefer A over C
  - Context-free ordering: If an agent prefers A over B, he will still do this when additional alternatives (C, D, …) are available



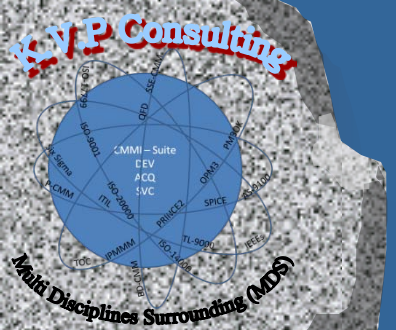
Game Theory

- Is an idealized abstraction of reality
- Is a normative, not a descriptive theory
  - It states only how people *should* behave if they wish to maximize their utility
  - It does not describe how people *actually* behave
- Can be tested empirically
  - Experimental gaming experiments



Game Theory: Assumptions

- There are two assumptions of *Common Knowledge and Rationality* (CKR)
- CKR 1: The specification of the game (e.g. number of players, payoff functions) are known to all players
- CKR 2: All players are rational in the sense of Expected Utility Theory
  - → All players will choose strategies that will maximize their individual expected utilities

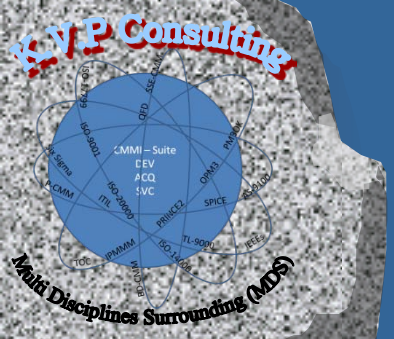


Game Theory: Nash Equilibrium

- A Nash equilibrium can be seen as a cell in a payoff matrix and thus a certain combination of players‘ actions
- *Definition*: no player has anything to gain by unilaterally changing his or her strategy
- A game can have more than one Nash equilibrium

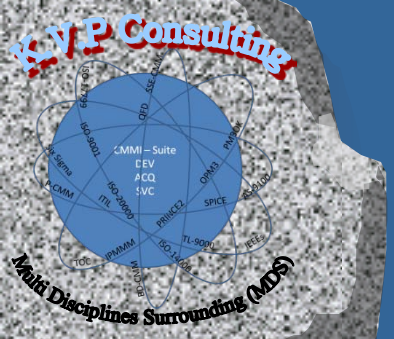
Note: equilibria are highlighted by red boxes

Example: Nash equilibrium		Player 2	
		C	D
Player 1	C	3, 3	0, 2
	D	2, 0	1, 1



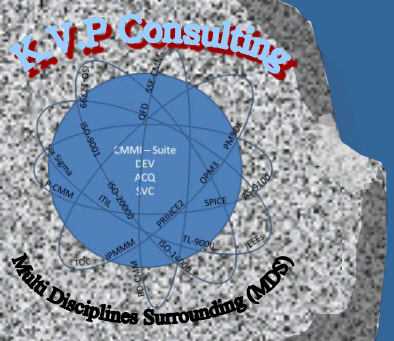
Team Reasoning

- Explanation for cooperative behavior in social dilemmas
- A team reasoning player…
  - maximizes the collective payoff
  - chooses not by individual but by *collective preference*
  - violates the second assumption of Common Knowledge and Rationality on which game theory is based upon
    - CKR 2: “All players will choose strategies that will maximize their individual expected utilities”

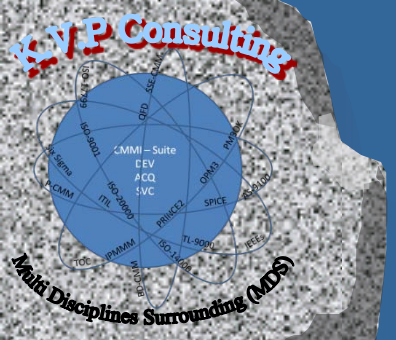


Summary and Conclusion

- Classical Game Theory…
  - is a *normative* theory based on Expected Utility Theory
  - is not able to predict decisions in all interactive situations but sometimes remains *indetermined*
    and…
  - predicts self-defeating behavior in *social dilemmas*
- Psychological Game Theory…
  - Suggests elements to explain empirical data which is contrary to the Classical Game Theory
- Conclusion: Classical Game Theory is useful to understand social interactions but needs to be modified

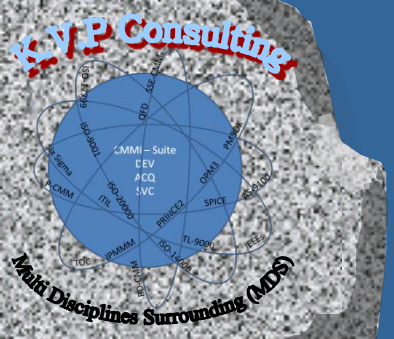


Bayesian Belief Network



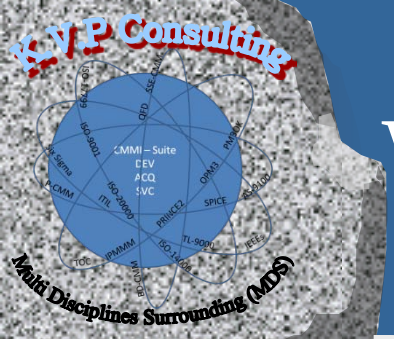
Background

- There has been little emphasis on the decision making process on project \ program scoping.
- Scoping Rationale (SR) as a result of a decision is often not clearly captured
- Even when SR is captured, it is often difficult to explain how decisions relate to and affect the architecture considerations
- Change impact cannot be systematically reasoned or explained during the different phases
- It is difficult to quantify the impact of changes in requirement, design or decision



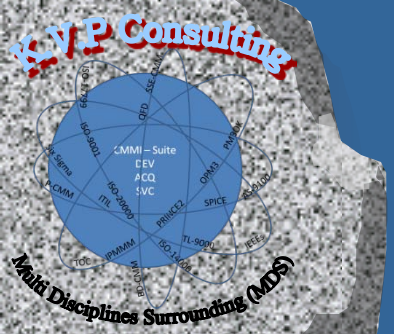
Project \ Product Scoping Decisions

- Early Decision Making
- Consider Multiple Factors including Functional Requirements, Non-Functional Requirements and Environmental Factors
- Consider Different Perspectives and Viewpoints
- Directly and Indirectly Influence the Design Structure of the System
- Create / Modify Design Elements to Satisfy System Goals / Sub-goals



What Is Decision Analysis?

- Decision Analysis Provides Effective Methods for Organizing a Complex Problem into a Structure that can be Analyzed
  - Identifies Possible Courses of Action
  - Identifies Possible Outcomes
  - Identifies Likelihood of the Outcomes
  - Identifies Eventual Consequences
- Decision Analysis Provides the Methods to Trade Off Benefits Against Costs
- Decision Analysis Allows People to Make Effective Decisions More Consistently



Problem Statements

- How to capture rationale and represent architecture considerations related decisions in relation to design artefacts?
- What is the change impact to the system when one or more requirements, designs or decisions are to change?

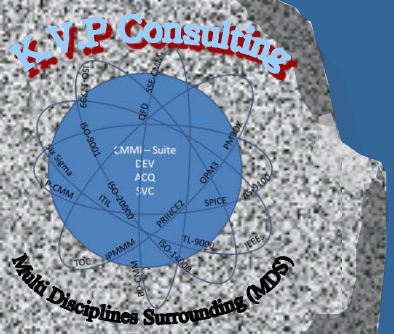
- **Tool walk through**

Game Theory and Bayesian

Static Bayesian Games

Multi-stage games

Dynamic Bayesian Games



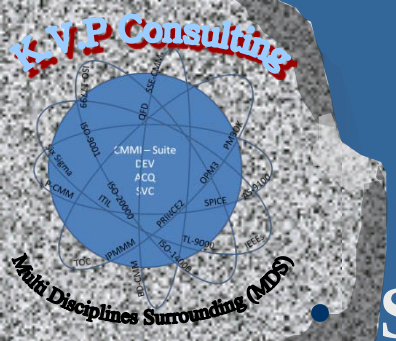
What is Bayesian Game?

Game in strategic form

- Complete information(each player has perfect information regarding the element of the game)
- Iterated deletion of dominated strategy, Nash equilibrium: solutions of the game in strategic form

Bayesian Game

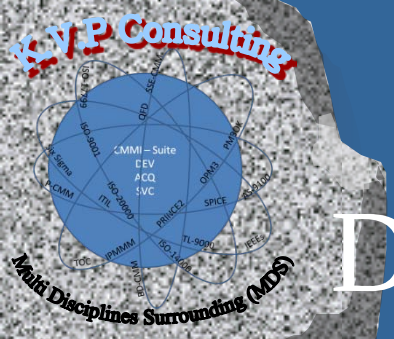
- A game with incomplete information
- Each player has initial private information,
- Bayesian equilibrium: solution of the Bayesian game



Static Bayesian Games

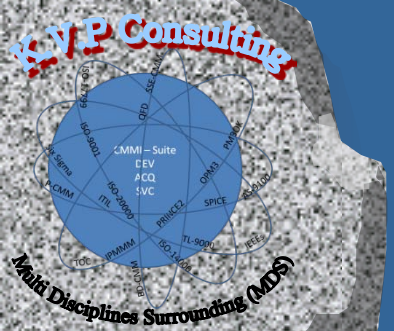
Static Games of Incomplete Information

- In many economically important situations the game may begin with some player having private information about something relevant to her decision making.
- These are called games of *incomplete information*, or *Bayesian* games. (Incomplete information is not to be confused with *imperfect* information in which players do not perfectly observe the actions of other players.)
- Although any given player does not know the private information of an opponent, she will have some beliefs about what the opponent knows, and we will assume that these beliefs are common knowledge.
- In many cases of interest we will be able to model the informational asymmetry by specifying that each player knows her own payoff function, but that she is uncertain about what her opponents' payoff functions are



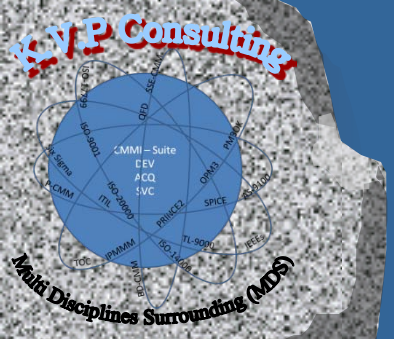
Difference Dynamics and Statics

- The only thing to learn in static game with asymmetric information is when types are correlated and then information about own type reveals info about types of other players
  - Usually, independent types are assumed
- In dynamic games with asymmetric information players may learn about types of other players through actions that are chosen before they themselves have to make decisions



Important class of signaling games

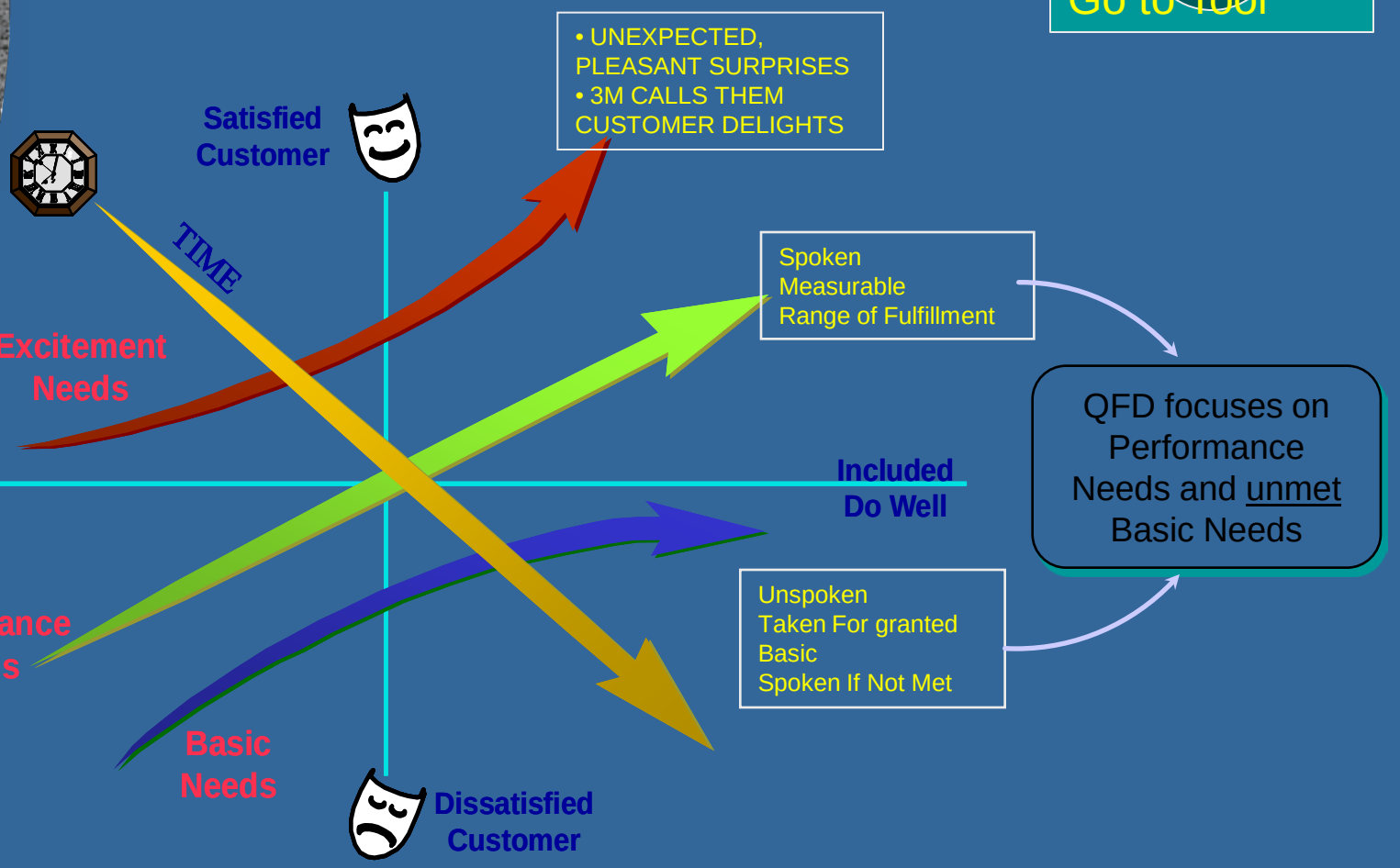
- In signaling games there are two players, Sender and Receiver
- Type of Sender is private information, sender takes an action
  - Strategy is action depending on type
- Receiver takes an action after observing action taken by the sender
- Type of sender may be inferred (revealed) on the basis of the action that is actually taken



Quality Function Deployment (QFD)

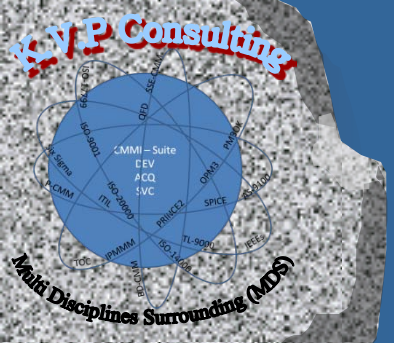
Kano Customer Need Model
Where does QFD fit?

Go to Tool



RECOGNIZE

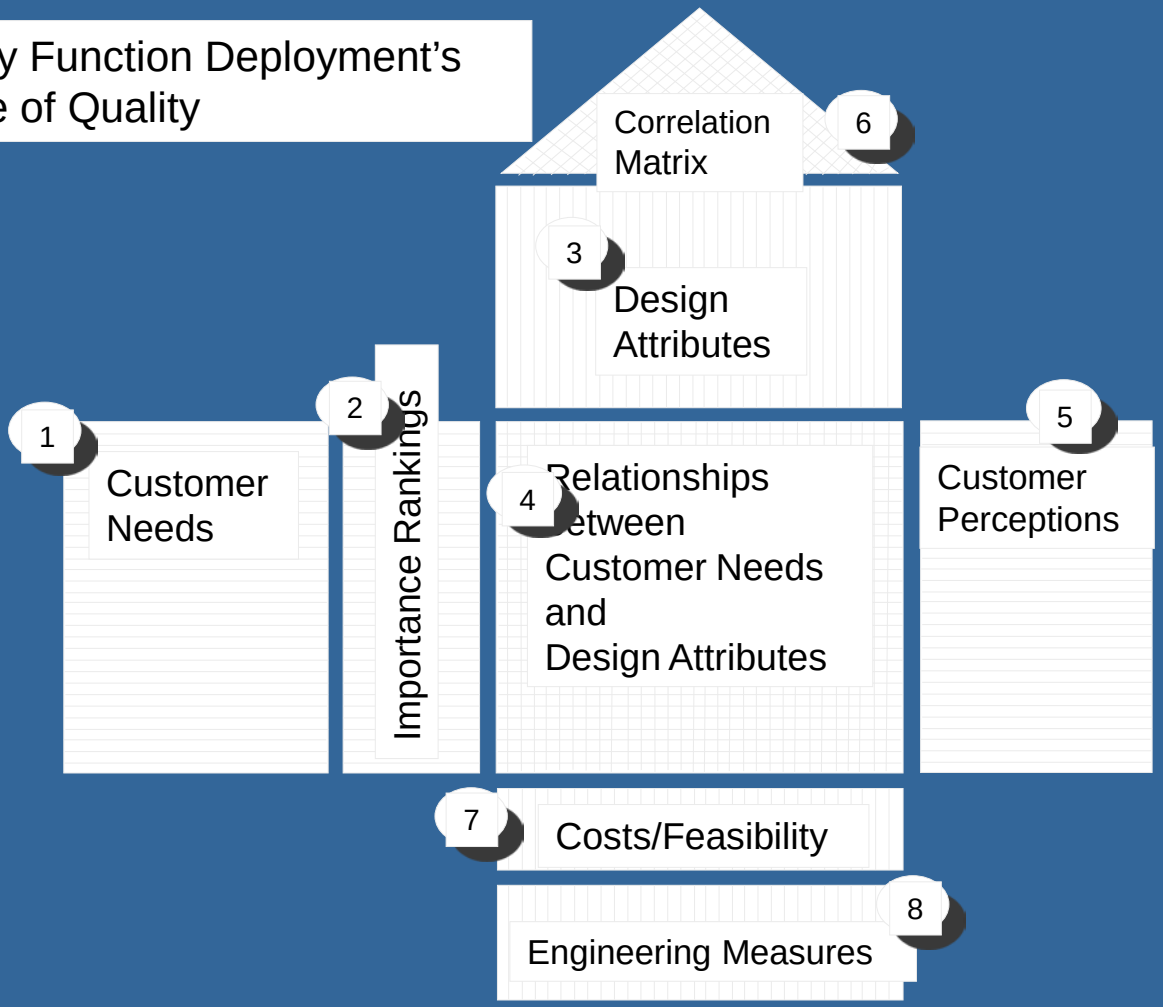
1) The Impact of Needs on the Customer
2) That Customer Needs Change With Time
3) The impact of Communication of Customer Wants Throughout the Organization

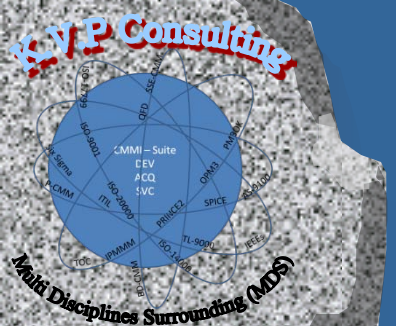


Kano Customer Need Model

Dissatisfiers	**Those needs that are EXPECTED in a product or service. These are generally not stated by customers but are assumed as given. If they are not present, the customer is dissatisfied.**
Satisfiers	**Needs that customers SAY THEY WANT. Fulfilling these needs creates satisfaction.**
Exciters / Delighters	**New or Innovative features that customers do not expect. The presence of such unexpected features leads to high perceptions of quality.**

Quality Function Deployment's House of Quality





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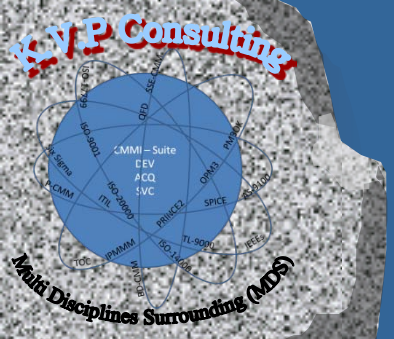
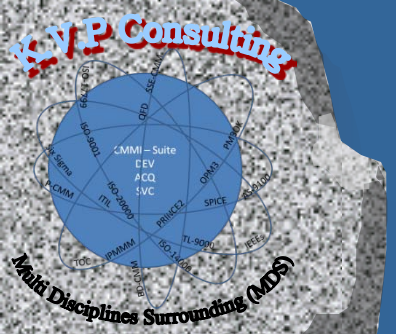


Business Challenges

- Complex Product Development Initiatives
- Communications Flow Down Difficult
- Expectations Get Lost
- New Product Initiatives / Inventions
- Lack \ unclear Structure or Logic to the Allocation of Development Resources.
- Large Complex or Global Teams
- Challenges in processes efficiency And/or Effectiveness
- Teamwork coordination Issues
- Conflicts in Product Development Times
- Excessive Redesign
- Changing Teams
- Problem Solving, or Fire Fighting.



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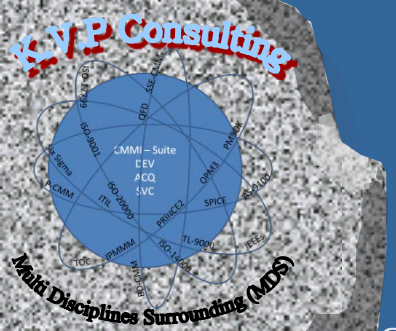
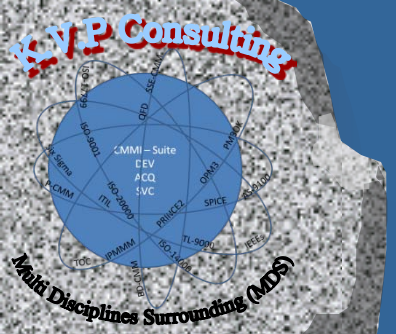


Business Goals

- Simplified the Product Development Initiatives to clear scope and users
- Identify, map and assign appropriate priorities the different stakeholders and commitments
- Identify and predict the New Product Initiatives / Inventions impact on the program and other stakeholders
- Identify and predict the Large Complex or Global Teams coordination and alignment efforts Inventions impact on the program and other team members \ teams
- Identify and predict processes efficiency And/or Effectiveness impact on the program and teams
- Identify and predict Conflicts in Product Development Time vs. the stakeholders expectations
- Identify and predict redesign Effectiveness impact on the program and teams
- Identify and predict changing in teams impact on the program and teams
- How to choose the right way Problem Solving, or Fire Fighting based on quantitative and prediction of impact analysis



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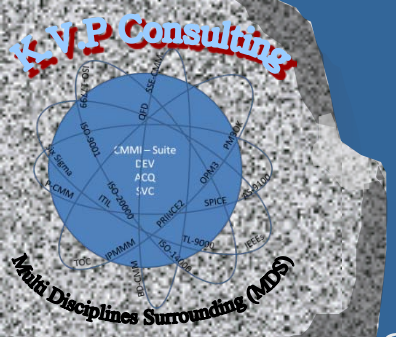
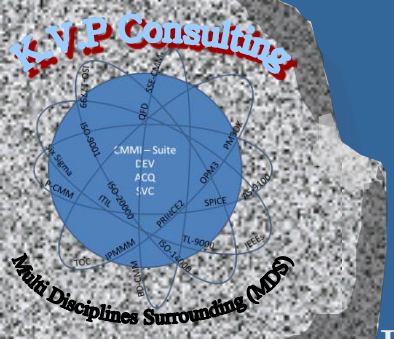


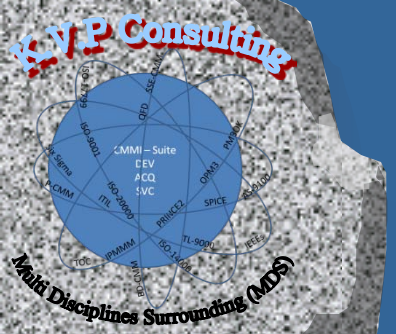
Goal Alignment with Models - 1

- Simplified the Product Development Initiatives to clear scope and users
  - **QFD and Dynamic Bayesian Games**
- Identify, map and assign appropriate priorities the different stakeholders and commitments
  - **Quality Function Deployment**
- Identify and predict the New Product Initiatives / Inventions impact on the program and other stakeholders
  - **Game Theory**; **Bayesian Networks and Dynamic Bayesian Games**
- Identify and predict the Large Complex or Global Teams coordination and alignment efforts Inventions impact on the program and other team members \ teams
  - **Bayesian Networks and Dynamic Bayesian Games**



Goal Alignment with Models - 2

- Identify and predict processes efficiency And/or Effectiveness impact on the program and teams
  - **Bayesian Networks and Dynamic Bayesian Games**
- Identify and predict Conflicts in Product Development Time vs. the stakeholders expectations
  - **Game Theory**; **Quality Function Deployment**; **Bayesian Networks and Dynamic Bayesian Games**
- Identify and predict redesign Effectiveness impact on the program and teams
  - **Quality Function Deployment**; **Dynamic Bayesian Games**
- Identify and predict changing in teams impact on the program and teams
  - **Dynamic Bayesian Games**
- How to choose the right way Problem Solving, or Fire Fighting based on quantitative and prediction of impact analysis
  - **Bayesian Networks and Dynamic Bayesian Games**



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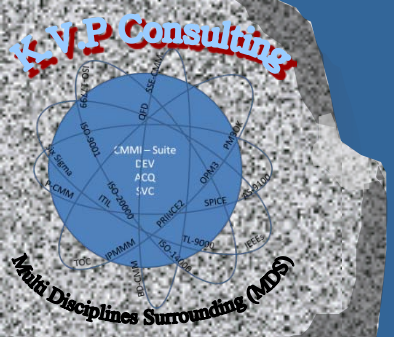
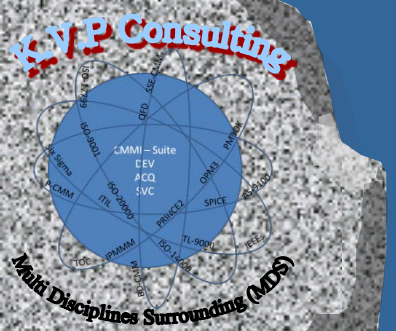


Outcome(s) Predicted

- We have developed players \ stakeholders map we have include the description of the expected outcome(s) and its influence on the ‘project’ performance
- **The map template and example will be uploaded to the website**



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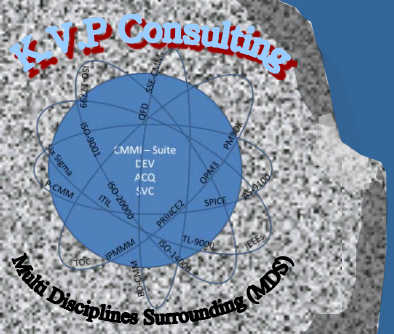
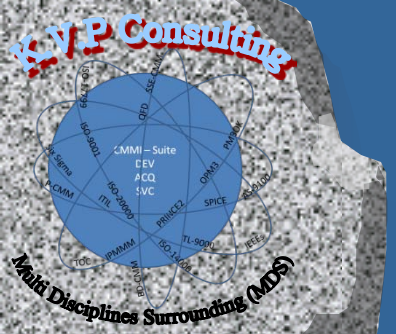


Stakeholder Audience

- We have developed a players \ stakeholders map we have include the description of the expected outcome(s) and its influence on the ‘project’ performance, used to communication and negotiations on decisions
- **The map template and example will be uploaded to the website**



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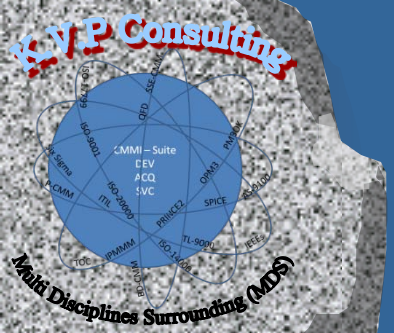
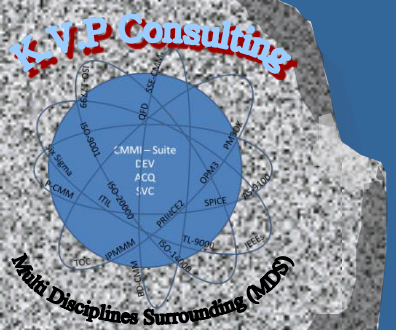


Factors used in the Process Performance Model

- We include the factors in our data map tool (e.g. influence)
- **The map template and example will be uploaded to the website**



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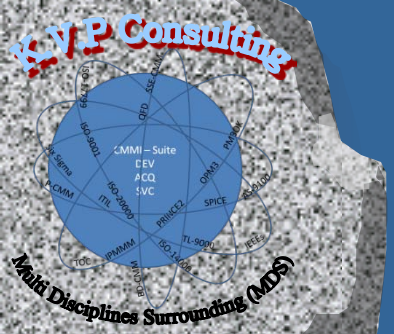
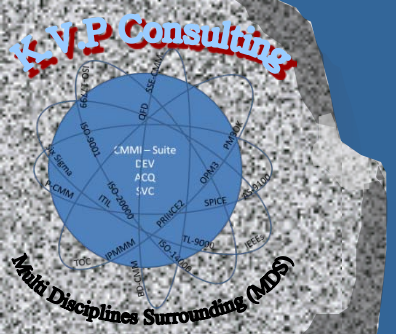


Tool Used

Game Theory (Using Excel)

Bayesian Belief Network (Using HUGIN)

Quality Function Deployment (QFD) for Requirement Development (Using Excel)



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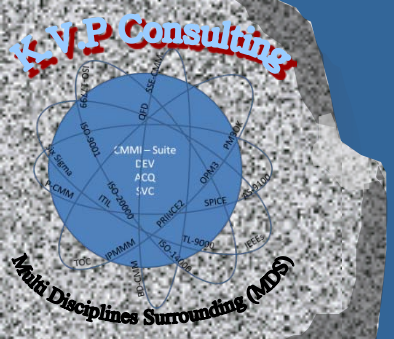
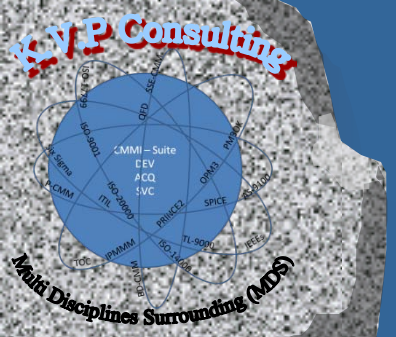


Challenges

- How was the voice of the customer determined?
- How were the design requirements (etc) determined? Challenge the usual in-house standards.
- How do we compare to our competition?
- What opportunities can we identify to gain a competitive edge?
- What further information do we need? How can we get it?
- How can we proceed with what we have?



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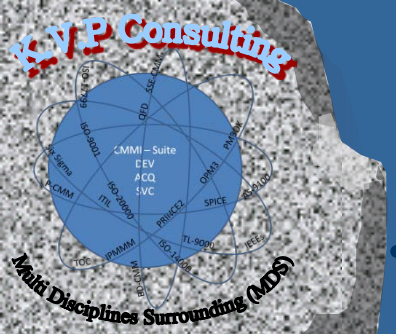
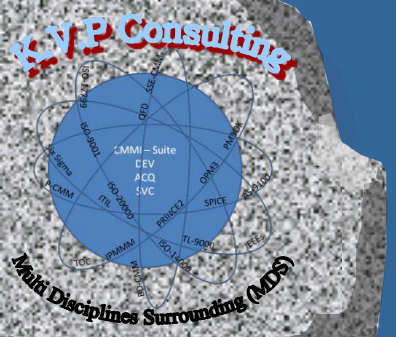


What Worked Well

- What worked well
  - Senior staff commitments
  - Stakeholders acceptance of the balancing results
  - Stakeholders acceptance of their ‘position’ and weight
- Between our side benefits
  - ‘snow ball’ effect from other departments
  - Request for generic model development
  - Request to adjust it to strategic and multi year programs
- Stakeholder inputs
  - Give clear world view of all aspects
  - Reduce the decision making and factors analysis complexity
  - The historical data base from past projects reduce resistance
- Model development team member inputs
  - Create more clear understanding on the
  - The historical data base from past projects reduce development time



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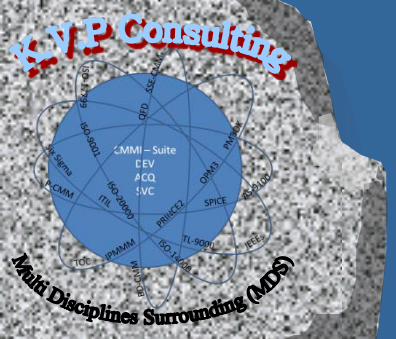
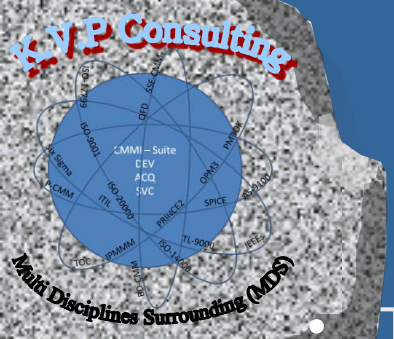


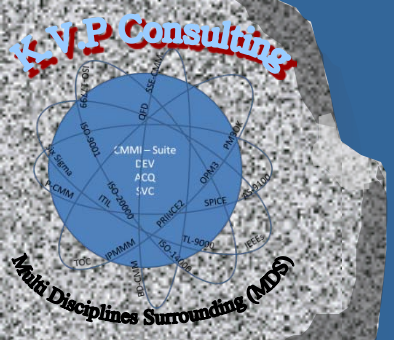
Summary - 1

- The process may look simple, but requires effort.
- Many of the entries look obvious - after they are written down.
- If there aren't some "tough spots" the first time, it probably isn't being done right!
- Focus on the end-user customer.
- Charts are not the objective.
- Charts are the means of achieving the objective.
- Find reasons to succeed, not excuses for failure.



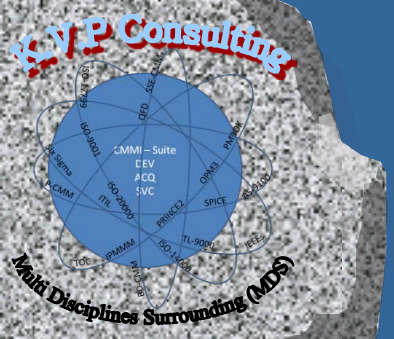
Summary - 2

- The combined methods that we have developed and use meant to serve as the main support tool for the project \ program Management, That Focuses on What the Customer Wants; and Then Provides a Systematic Approach, Involving Communication Between All stakeholders and Areas of the Organization, to Make Sure These Wants Are Satisfied within the given constraints.
- Decision Analysis Provides the Structure and Guidance for Systematic Thinking
- Decision Analysis Process Organizes a Complex Problem into a Structure that can be Analyzed
- Good Decision Analysis Requires Clear Thinking; Sloppy Thinking Results in Worthless Analysis!

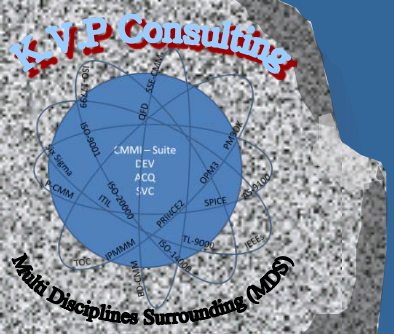


Additional Posts

- Game Theory Overview Presentation
- Bayesian Belief Network Overview Presentation
- Quality Function Deployment (QFD) Overview Presentation
- Players \ Stakeholders Map – Excel Based
- Data Type Map – Excel Based
- Bayesian Belief Network – HUGIN Based
  http://www.hugin.com/Products_Services/Products/Demo/Lite/
- Quality Function Deployment - Excel Based


J.P. Consulting
CMMI – Suite
DEV
ACQ
SVC
Multi Disciplines Surrounding (MDS)

Questions ?



Contact

Kobi Vider

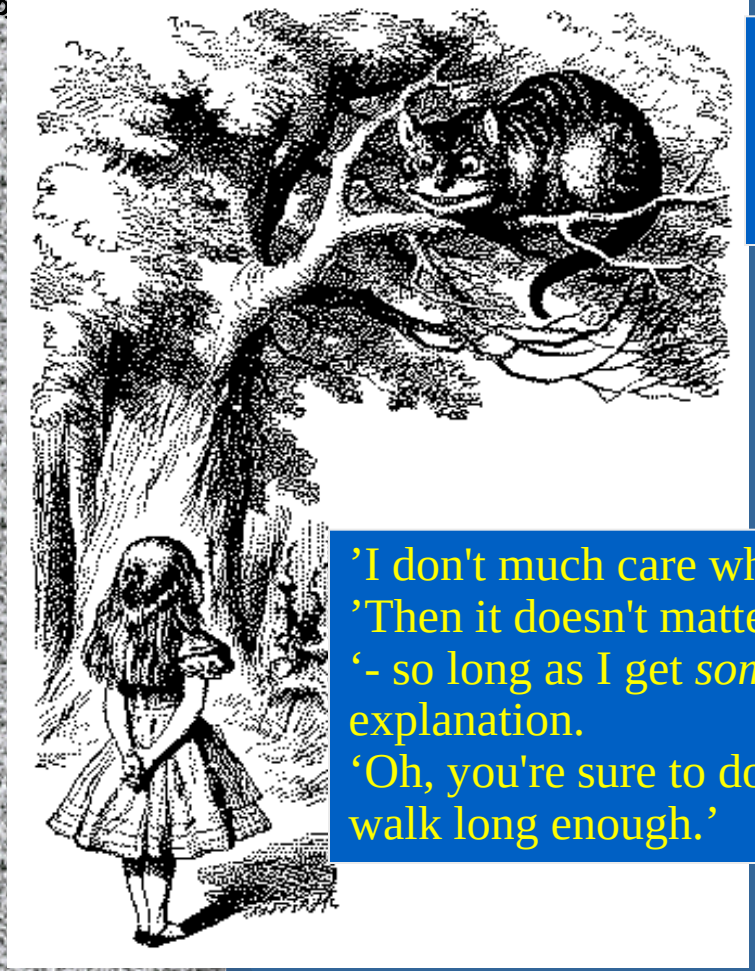
K.V.P Consulting

Kobi.Vider@hotmail.com

KobiVP@aol.com

Phone: +972522946676

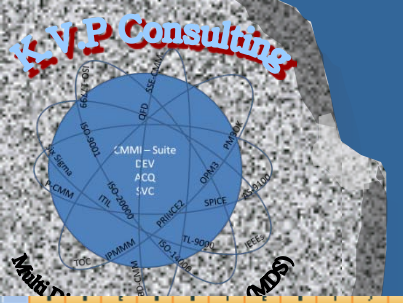
Why to Monitor Processes



‘Cheshire Puss,’ she began, … `Would you tell me, please, which way I ought to go from here?’
‘That depends a good deal on where you want to get to,' said the Cat.

’I don't much care where –’ said Alice.
’Then it doesn't matter which way you go,' said the Cat.
‘- so long as I get *somewhere*,' Alice added as an explanation.
‘Oh, you're sure to do that,' said the Cat, ‘if you only walk long enough.’

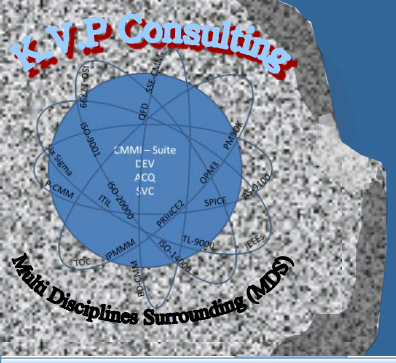
Tell me where you want to be and I will show (measure) you the way



"which way I ought to go from here"

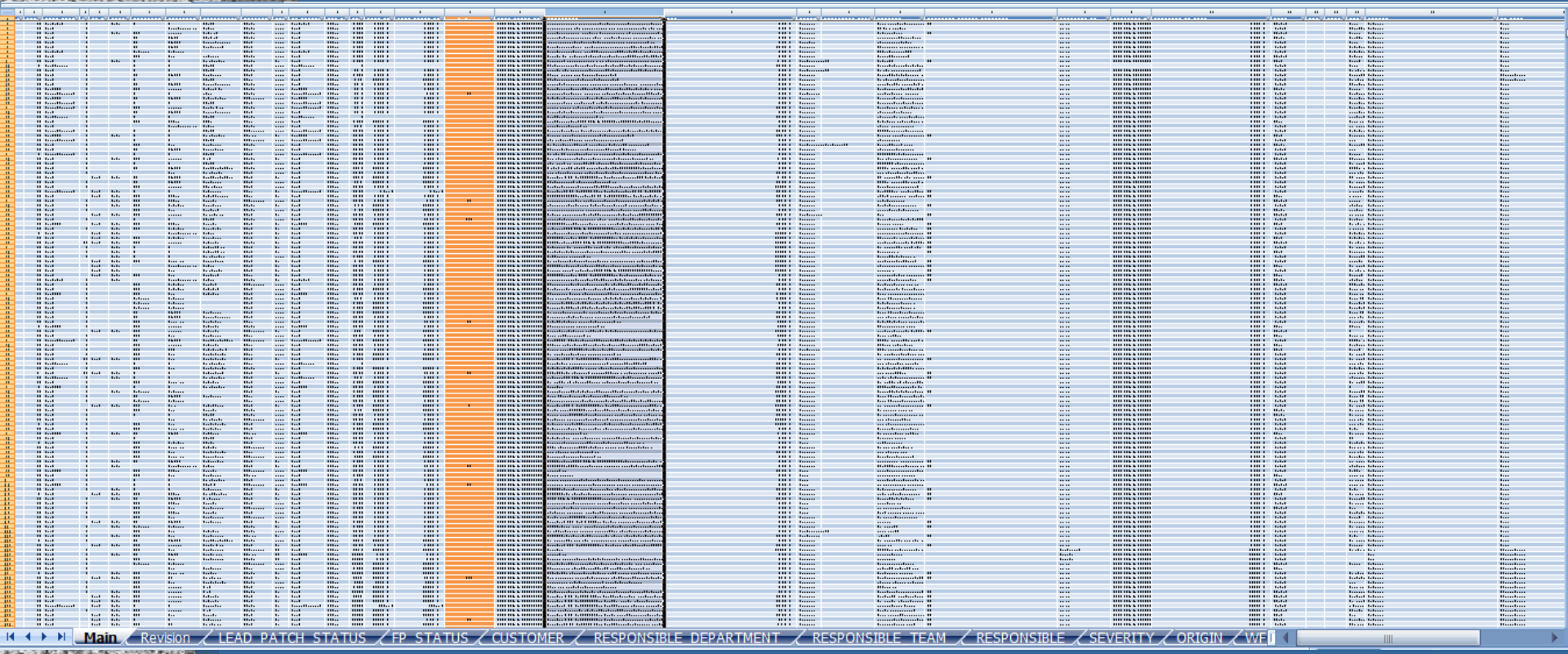
Call Center – Calls Database

~45000 Records
With
22 Attributes



"which way I ought to go from here"

Bug Database



~33000 Records
With
36 Attributes