An Econophysics Value Theory: Extension of the Original Model

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Towards an Inclusive Innovation

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Basic Econophysics Model Extensions for the Smart Phone Market

- Basic model
  - Econophysics analogy 2016-2017
- Extensions of the prior model to adoption rate curves:
  - Calculating Protovalue
  - Notional example of smart phone adoption rates
  - Innovators and Imitators adopter models
- Implications for use of the model with actual data

Figure 1: Econophysics Model: How To Calculate Market Performance from Fundamental Parameters

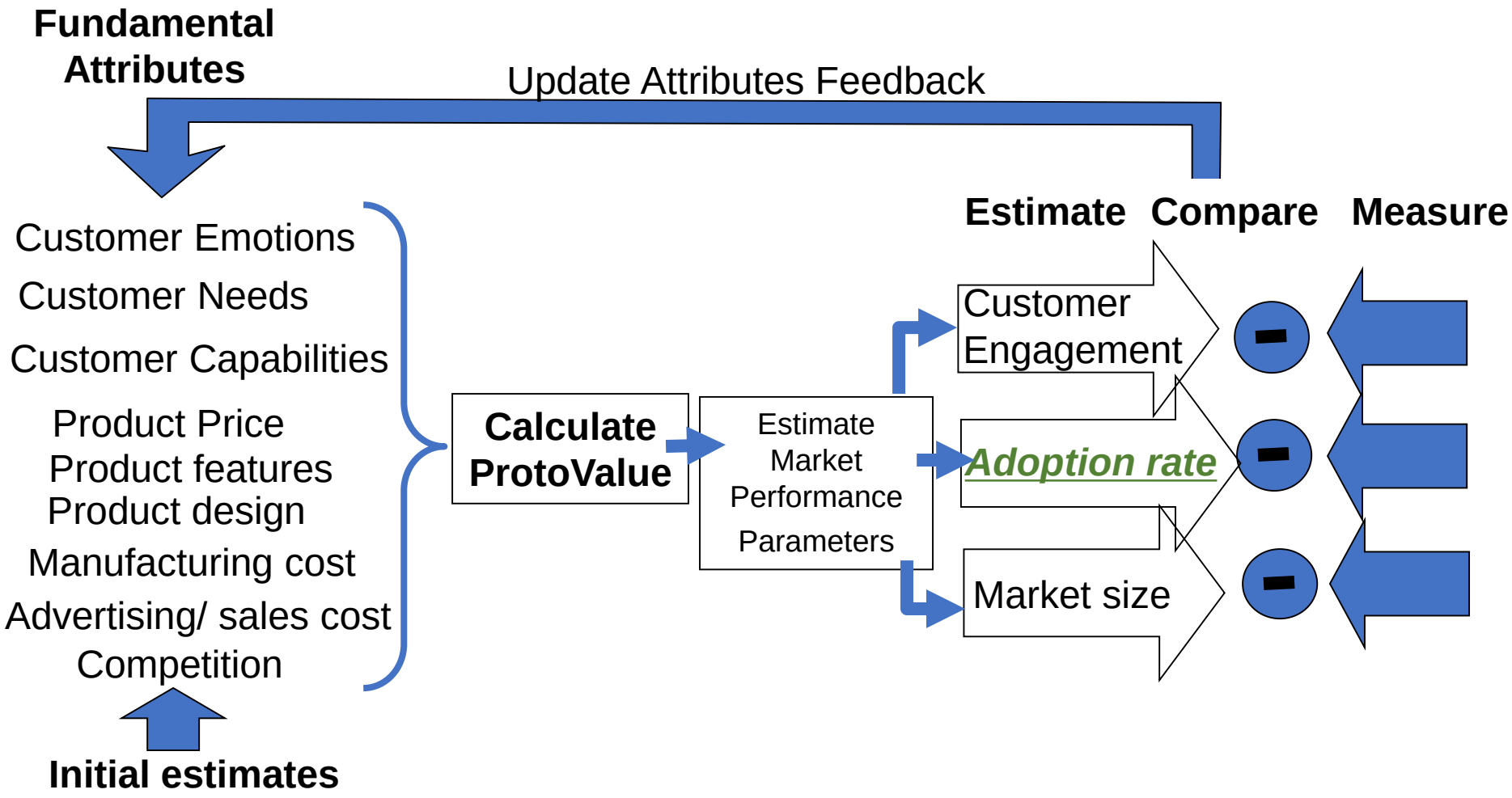
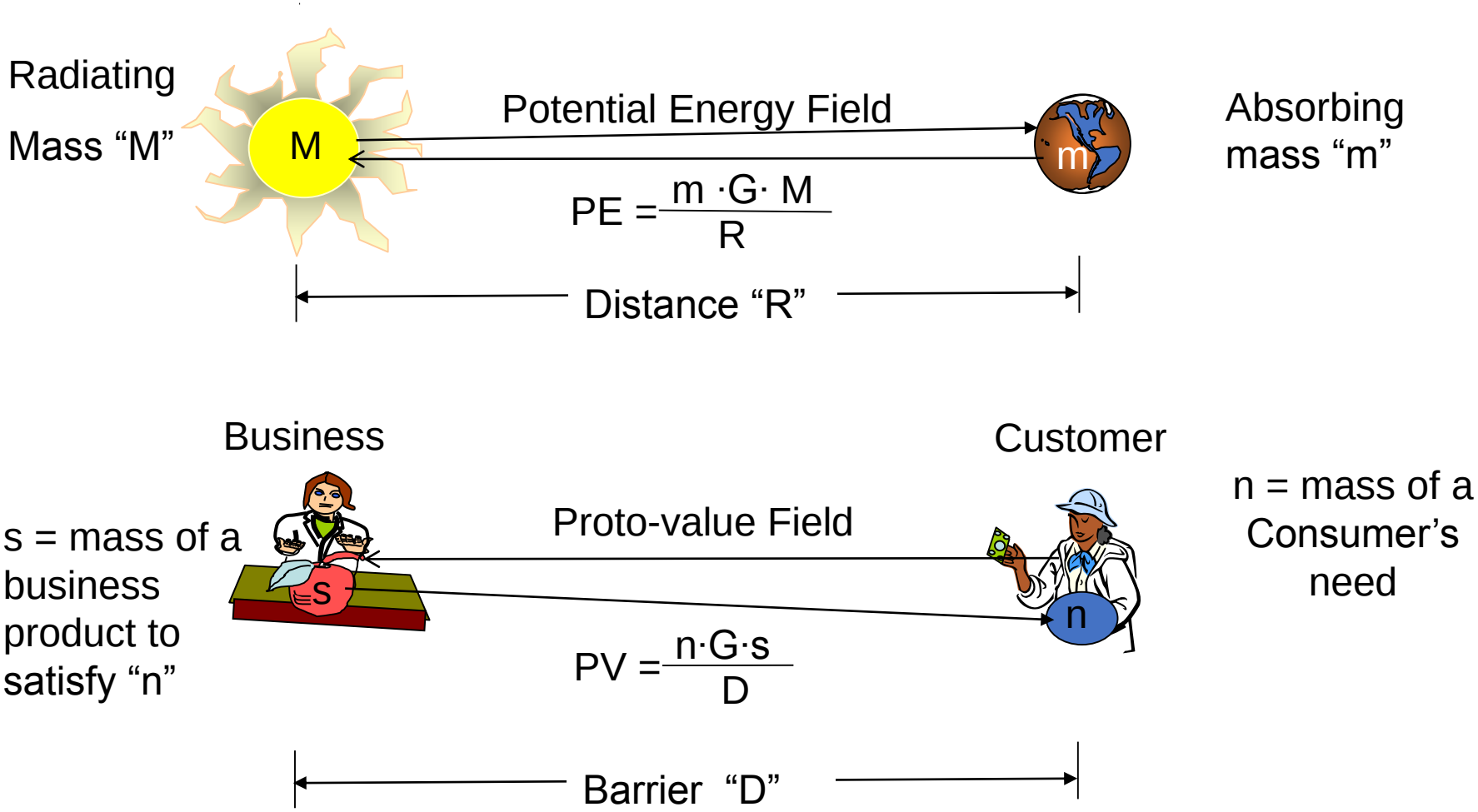


Diagram 2: Mass and Gravity Analogy



Economics to Physics Analogy

Economics	Physics
Protovalue: Useful Potential Value / Cost Barriers) Work Energy: Use or Work Value	Organized Potential Energy Organized Kinetic Energy
Exchange Energy Point of Sale: Δ in Protovalue (PV_a After Exchange – PV_b Before the Exchange) Definition: $PV_b = PV_p + WV_\$$ $PV_a = WV_p + PV_\$$	Δ Energy = Organized Potential Energy + Organized Kinetic Energy. Note: Surrogate Kinetic Energy is $
Satisfaction = Exchange Rate Point of Sale: Satisfaction = Expected Exchange Energy (E_x) * Length of Time in Hours Actual Satisfaction = Actual Exchange Energy (E_x) * Length of Time in hours.	Amount of Action: Action = Energy * Δ Time ΔA = Δ PE * Δ Time ΔA = Δ KE * Δ Time

Table 1: Econophysics Concepts Match (2016)

ECONOMICS	PHYSICS
ProtoValue	Potential Energy
ProtoValue Ratio = Satisfaction/Distance	Energy = Action/Time
Satisfaction is a need being satisfied	Action is a change being made
Happiness = rate at which satisfaction happens	Energy = rate of Action flowing
Proto-Value = Potential Happiness	Potential Energy = potential rate of Action flow
Distance = Barriers to Satisfaction	Distance = Radius between masses

Amount of Satisfaction = Amount of Need * Need to Solution Function* Amount of Solution

Definition of Terms: Analogy Physics–Economics (2017)

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Definition of Terms: Analogy Between Physics and Psycho-Economics:		
Kinetic Energy	KE	Actual rate of satisfaction
Work Energy	WE	Useful actual rate of satisfaction that fits a need
Potential Energy	PE	Potential rate of satisfaction, expected or hoped for satisfaction rate
Lagrangian Energy	(KE- PE)	Happiness , Difference between actual and hoped for rate of satisfaction. Positive values are pleasure. negative values are pain
Hamiltonian Energy	H = KE+PE	Heaftiness , Total capacity of an economic entity (consumer or buainess)
Einstein Mass	$m=H/c^2$	Another term for identifying the concept of Heftiness
Speed of light in vacuum	c	Speed of Now in equilibrium economy
A bit of Kinetic Action	$KE \cdot dt$	a bit of Actual Satisfaction
A bit of Potential Action	$PE \cdot dt$	a bit Potential Satisfaction, a Need bit
Macroscopic Action	$S = \int (KE - PE) \cdot dt$	Satisfaction for a tangibly large size activity
Minimum Action	$\delta S=0$	Minimum pain or maximum pleasure
Principle		Principle

"Physical Material only will only move along trajectories that minimize the action relative to alternative neighboring paths"
"Economic entities will only engage in exchange sequences that maximize their pleasure relative to available alternatives."

Definition of Terms: Analogy Physics--Economics (continued)

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Position vector of attributes in a physical quantity	$\mathbf{q}$	Position of ownership in an economic quantity
Momentum vector	$\mathbf{p_q} = dS/d\mathbf{q}$	The rate of change of satisfaction when changing ones ownership of a quantity
Force in a quantity diection	$\mathbf{F}_q = d\mathbf{p_q}/dt$	The force felt by an economic entity when it feels the opportunity for changing its satisfaction by changing its ownership of a quantity
Equilibrium condition	$0 = \sum_i \mathbf{F}_{qi}$	Vector sum of all forces of all quantities (qi) are zero
Unit vectors of quantities	$\mathbf{u_q}$, $\mathbf{u}$	Units of ownership (apples, dollars,..)
Measurement of a physical quantity	$\mathbf{q} = \#_q \cdot \mathbf{u_q}$	Measurement of an eqonomic quantity
Generalized Physical space Dimensions of measurement Types	x,y,z	i,j,k Quantity type dimensions define need, or product categories
Vectors in physical space	$\mathbf{q_x}, \mathbf{q_y}, \mathbf{q_z} \ldots \mathbf{q_f}$	$\mathbf{q_i}, \mathbf{q_j}, \mathbf{q_k} \ldots$ Vectors in economic space
Maximum Quantity	$\mathbf{q_{f,max}} = \max\#_q \cdot \mathbf{u_q}$	
Volume of physical space	$\mathbf{q_{x,max}} \cdot \mathbf{q_{x,max}} \cdot \mathbf{q_{x,max}} \cdots \mathbf{q_{f,max}}$	
	$\mathbf{q_{i,max}} \cdot \mathbf{q_{j,max}} \cdot \mathbf{q_{k,max}} \cdots \mathbf{q_{f,max}}$	**Volume of Economy**
A physical particle	[Name], [a],[b]	Economic entity

Rule: most economic or physical symbols can be augmented to refer to specific individuals , entities or symbols.
For example if C = customer , $ = money, B = business, a = apple then
KE(C,$) means the actual rate of satisfaction the customer receives from his money.
KE(B,a) means the actual rate of satisfaction the business receives from his product which is in this example the apple

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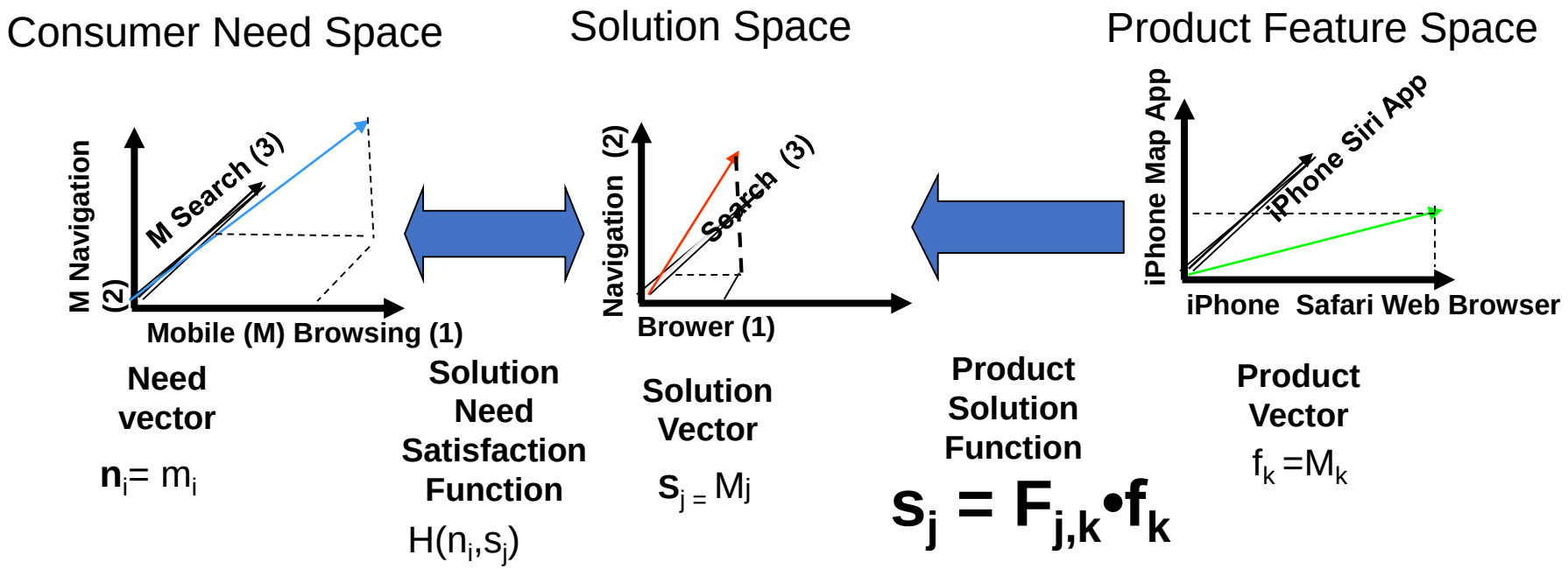
Phases of Adoption

Phase	Economics	Physics
Pre Product Introduction Phase I	Protovalue: Useful Potential Value / Cost Barriers)	Organized Potential Energy (PE)
Innovator Phase II • Point of Sale and Actual Use	Exchange Energy Point of Sale: Δ in Protovalue (PV_a After Exchange – PV_b Before the Exchange) Definition: $PV_b = PV_p + WV_\$$ $PV_a = WV_p + PV_\$$	Δ Energy = Organized Potential Energy + Organized Kinetic Energy. Note: Surrogate Kinetic Energy is $
• Satisfaction = Exchange Rate	Point of Sale: Satisfaction = Expected Exchange Energy (E_x) * Length of Time in Hours Actual Satisfaction = Actual Exchange Energy (E_x) * Length of Time in hours.	Amount of Action: Action = Energy * Δ Time ΔA = Δ PE * Δ Time ΔA = Δ KE * Δ Time
Imitator Phase III • Point of Sale and Actual Use	Point of Sale: Satisfaction = Expected Exchange Energy (E_x) derived from innovator actual use or WV * Length of Time in Hours	Amount of Action: Action = Energy * Δ Time ΔA = Δ PE * Δ Time
• Satisfaction = Exchange Rate	Actual Satisfaction = Actual Exchange Energy (E_x) * Length of Time in hours.	ΔA = Δ KE * Δ Time

Phase I - Pre Product Introduction: Proto Value
Smart Phone Platform Feature Set Example

Physics Analogy Equation for PE $PE = \Sigma_{i,j} \frac{mj \cdot Gji \cdot Mi}{Rji}$

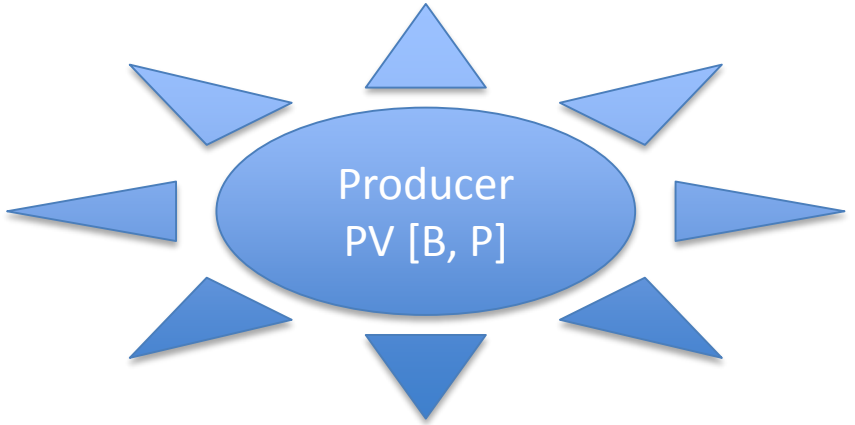
Proto Value Matrix Calculation $PV = \Sigma_{i,j} \frac{n_i \cdot G_{ij} \cdot s_j}{D} = \Sigma_{i,j,k} n_i \bullet (H_{i,j/} \bullet F_{j,k}) / D_{ik} \bullet f_k$



Exchange Energy: Innovators

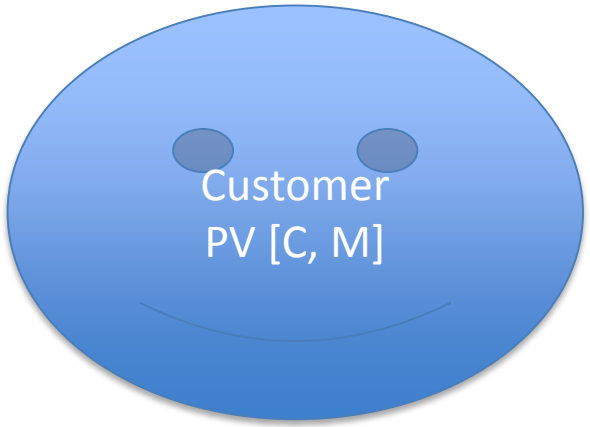
The perceived energy (protovalue) before the exchange $PV_{before} = PV[C, M] + PV[B, P]$

PV[C, M] = value customer assigns to the ownership of his money

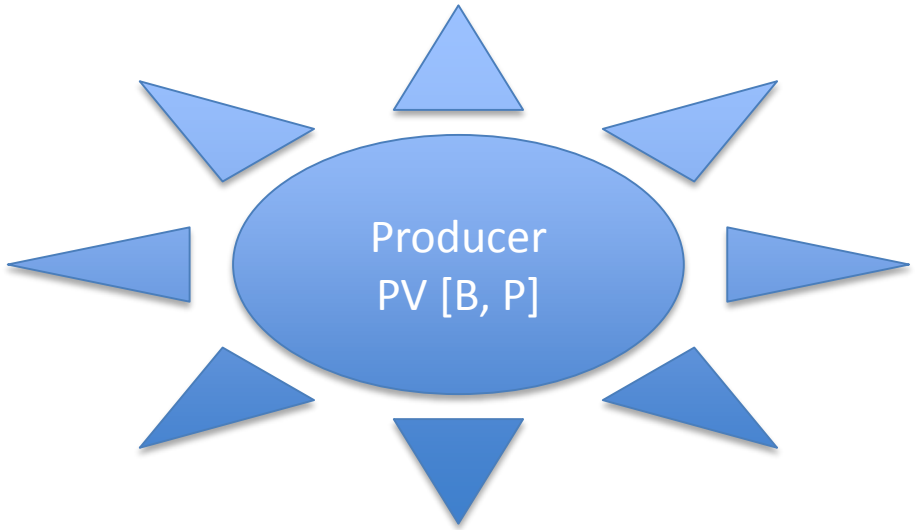


PV[B, P] = value the business assigns to the ownership of its product

The perceived energy after the exchange is $PV_{after} = PV[C,P] + PV[B,M]$



PV[C, P] = value customer assigns to the ownership of the businesses product



PV[B, M] = value the business assigns to the ownership of the customers money

The change in perceived value if the exchange happens is $PVx = PV_{after} - PV_{before}$

Exchange Energy Protovalue Applied to Estimate Adoption Rate

The potential energy (protovalue) before the exchange is

$$PV_{before} = PV[C, M] + PV[B, P]$$

The potential energy after the exchange is

$$PV_{after} = PV[C,P] + PV[B,M]$$

The change in potential energy if the exchange happens is

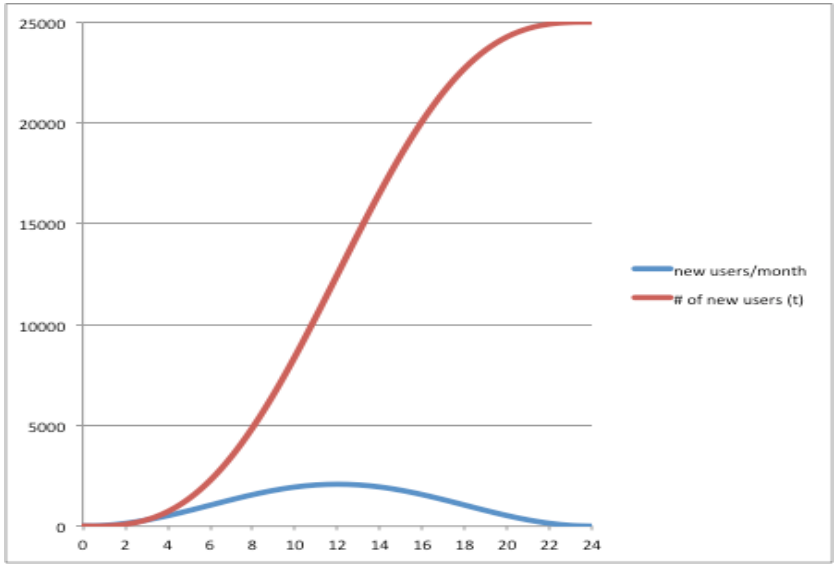
$$PVx = Pv_{after} - Pv_{before}$$

The more PV generated by an exchange the faster the exchange happens..

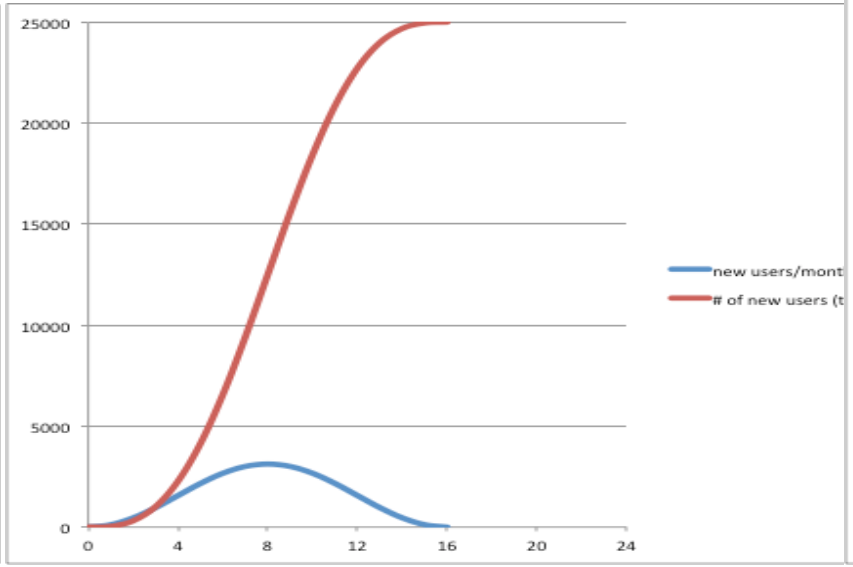
$$\Delta A / PVx = \Delta Tx$$

- **ta = time to total saturation**

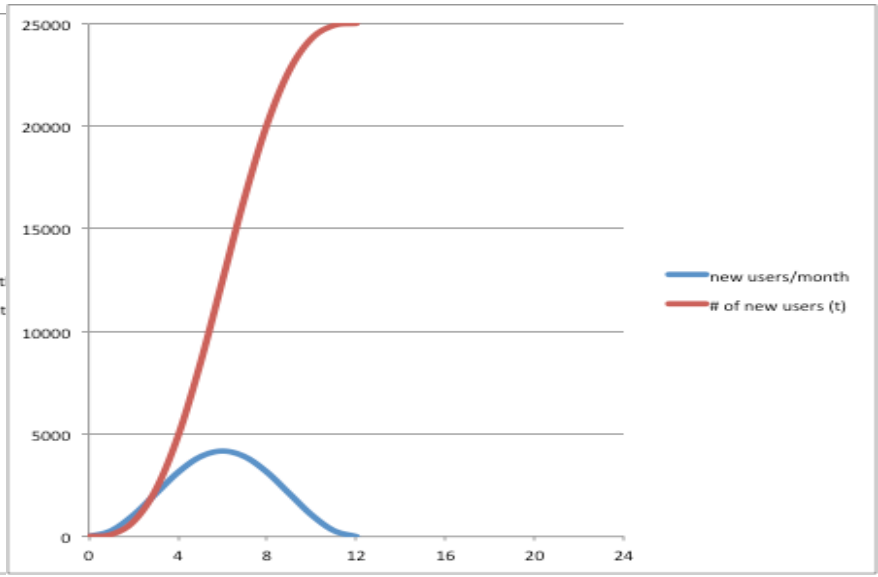
PVx = 100 ta = 24 months



PVx = 150 ta=16 months



PVx = 200 ta = 12 months



Note: 24 month time scale

Phase II – Innovator: Adoption Curve-- Smart Phone Platform Example

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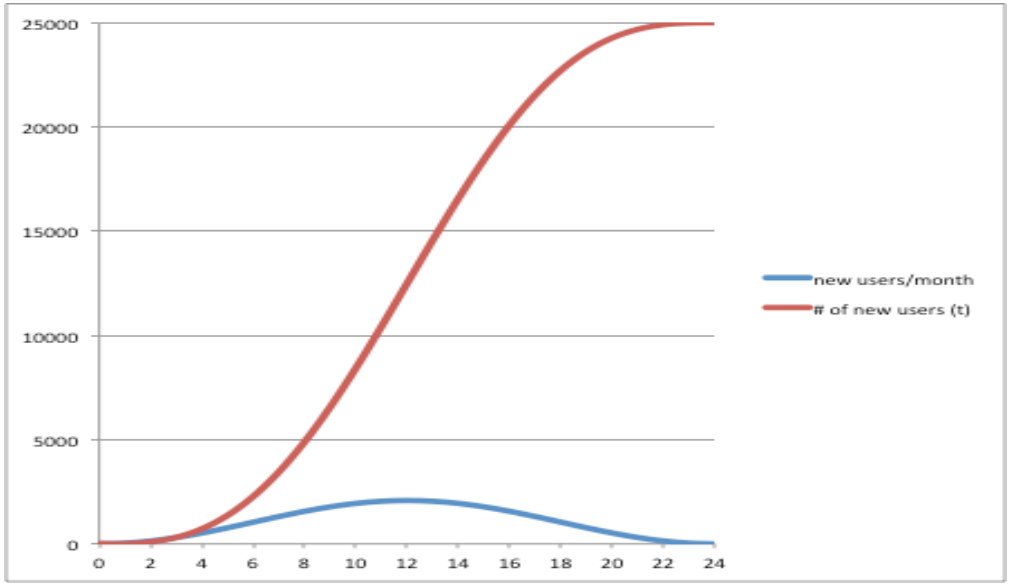
new users/month:

Formula $(1 - \text{Cos.}\ (E_x * t * 2\pi/h)) * k_u$

# of new users (t):

Formula $t - (h/(E_x * 2\pi) * \sin.\ (E_x * t * 2\pi/h)) * k_u$



- E_x = Exchange Energy
- t = Time in months
- h = (Ex) * ta
- k_u = n / ta
- ta = time to total saturation
- n = total population of users

Smart Phone Platform Example Assumptions

- E_x = 100 PV(E_x) or Exchange Energy
- time intervals = 0, 3, 6, 12, 18, 21, and 24 months
- ta = 24 months to achieve full saturation
- n = 25,0000 users

Calculations: new users/month

t = 0; (1-Cos. (100 * 0 * 2π /2400)) * 25,000/24 = 0
t = 3; (1-Cos. (100 * 3 * 2π / 2400)) * 25,000/24 = 302
t = 6; (1-Cos. (100 * 6 * 2π / 2400)) * 25,000/24 = 1,041
t = 12; (1-Cos. (100 * 12 * 2π /2400)) * 25,000/24 = 2,083
t= 18; (1-Cos. (100 * 18 * 2π /2400)) * 25,000/24 = 1,041
t= 21; (1-Cos. (100 * 21 * 2π /2400)) * 25,000/24 = 302
t= 24; (1-Cos. (100 * 24 * 2π /2400)) * 25,000/24 = 0

Calculations: # of new users (t)

t = 0; 0 - (3.83 * sin.(100 * 0 * 2π /2400)) * 25,000/24 = 0
t = 3; 3 - (3.82* sin.(100 * 3 * 2π /2400)) * 25,000/24 = 302
t = 6; 6 - (3.82* sin.(100 * 6 * 2π /2400)) * 25,000/24 = 2,270
t = 12; 12- (3.82 * sin.(100 * 12 * 2π /2400)) * 25,000/24 = 12,500
t= 18; 18 - (3.82* sin.(100 * 18* 2π /2400)) * 25,000/24 = 22,729
t= 21; 21 - (3.82* sin.(100 * 21 * 2π /2400)) * 25,000/24 = 24,697
t= 24; 24 - (3.82 * sin.(100 * 24 * 2π /2400)) * 25,000/24 = 25,000

Phase III – Imitator: Adoption Curve-- Smart Phone Platform Example

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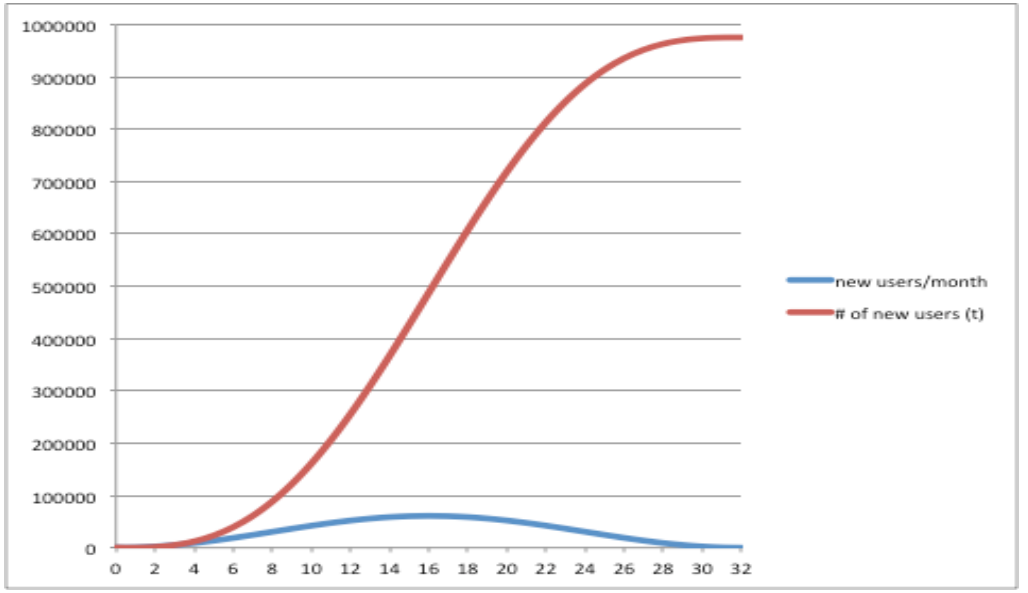
new users/month:

Formula $(1 - \text{Cos.}\ (E_x * t * 2\pi/h)) * k_u$

# of new users (t):

Formula $t - (h/(E_x * 2\pi) * \sin.\ (E_x * t * 2\pi/h)) * k_u$



- E_x = Exchange Energy
- t = Time in months
- h = (Ex) * ta
- k_u = n / ta
- ta = time to total saturation
- n = total population of users

Smart Phone Platform Example Assumptions

- E_x = 75 PV(E_x) or Exchange Energy
- time intervals = 0, 4, 8, 16, 24, 28, and 32 months
- ta = 32 months
- n = 975,000 users

Calculations: New users/month

t = 0; (1-Cos.((75 * 0 * 2π) /2400)) * 975,000/32 = 0
t = 4; (1-Cos. ((75 * 4 * 2π) /2400)) * 975,000/32 = 8,8836
t = 8; (1-Cos. ((75 * 8 * 2π) /2400)) * 975,000/32 = 30,469
t = 16; (1-Cos. ((75 * 16 * 2π) /2400)) * 975,000/32 = 60,938
t= 24; (1-Cos. ((75 * 24 * 2π) /2400)) * 975,000/32 = 30,469
t = 28; (1-Cos. ((75 * 28 * 2π) /2400)) * 975,000/32 = 8,836
t= 32; (1-Cos. ((75 * 32 * 2π) /2400)) * 975,000/32 = 0

Calculations: # of new users (t)

t = 0; 0 – (2400/(75 * 2π)) * sin.((75 * 0 * 2π) /2400)) * 975,000/32 = 0
t = 4; 4 – (2400/(75 * 2π)) * sin.((75 * 4 * 2π) /2400)) * 975,000/32 = 11,822
t = 8; 8 – (2400/(75 * 2π)) * sin.(75 * 8 * 2π) /2400)) * 975,000/32 = 88,481
t = 16; 16 – (2400/(75 * 2π)) * sin.((75 * 16 * 2π) /2400)) * 975,000/32 =487500
t= 24; 24 – (2400/(75 * 2π)) * sin.((75 * 24* 2π) /2400)) * 975,000/32 = 886,519
t= 28; 28 – (2400/(75 * 2π)) * sin.((75 * 28* 2π) /2400)) * 975,000/32 = 963,422
t= 32; 32 – (2400/(75 * 2π)) * sin.((75 * 32 * 2π) /2400) * 975,000/32 = 975,000

Implications for Introduction of Fintech in Japan

- Results of the analysis could be used to make feature level adoption rate predictions pre-product introduction and during the innovator customer segment adoption period to better predict imitator adoption rates
- Useful for:
  - Determining pace of build out and architecture of micro finance platform and network requirements(e.g., number of servers, support techs, COTS based user interface and devices), etc…
  - Creating advertising campaign based on need vectors
  - Selecting geographic areas for introduction
- With the extremely high penetration rate of smart phones in Japan, the country is ripe for broader adoption of Fintech

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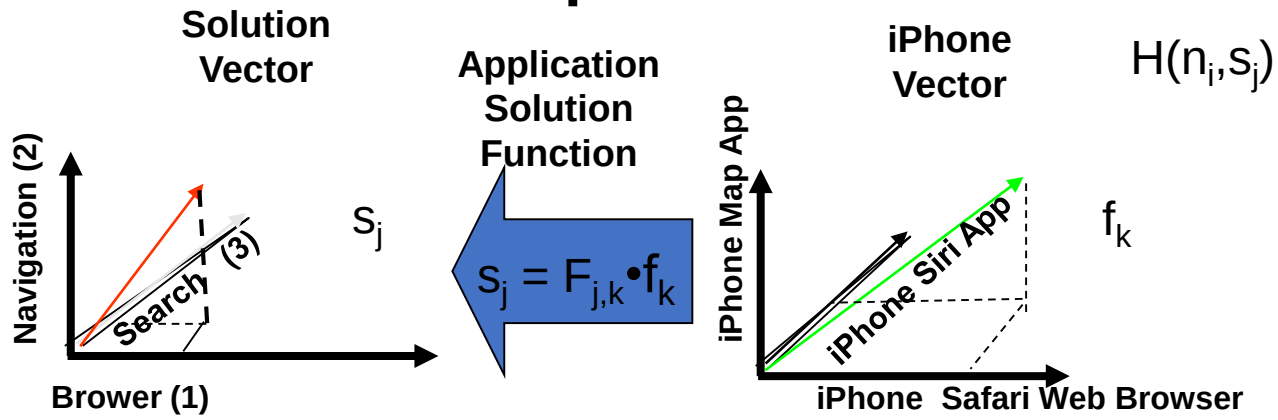
Back Up Slides

Phase I - Pre Product Introduction: Proto Value Mass: Multi-vector Coordinate System

Unit of Analysis	Vector	Economics	Physics
Use Time (Hours, Minutes, Seconds, Milliseconds)	Length of vector is determined by the amount of use	Needs, General Product Solution Feature, and Actual Product Feature	Action * Δ Time
Complexity, bits, Learning Time (unit of change or bits)	Length of vector is determined by the amount of time is takes an average person to learn how to complete a particular function or the number lines of code in a software program that could complete the same function	Common units of value	Δ Energy * Δ Time

Phase I - Pre Product Introduction: Proto Value

Fit: General Product Solution Transform to Product Feature Set - iPhone Feature Set Example



General Product Solution

iPhone Features

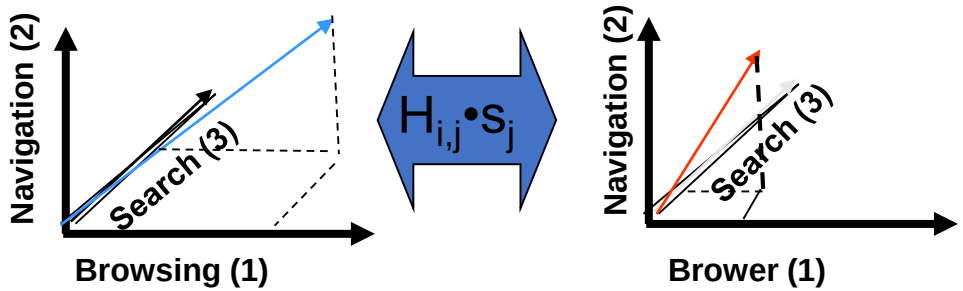
Brower (Hours per week)	2.55	=	.6	.2	.0	3	**iPhone Safari Web Browser (Hours per week)**
			0	5			
Navigation (Hours per week)	11.2		.0	.70	.0	16	**iPhone Map App (Hours per week)**
Search SP Intelligent Assistant (Hours per week)	2.4		.30	.40	.50	2	**iPhone Siri App (Hours per week)**

Phase I - Pre Product Introduction: Proto Value

Customer Need to General Product Solution Fitness Matrix: Smart Phone Platform Example

Customer Need to Solution Satisfaction Function Calculation $\mathbf{n}_i = H_{i,j} \bullet s_j$

Customer Need Space | Provider Solution Space



Customer Need Vector

General Product Solution

		Fitness Matrix				
Mobile Browse (Hours per week)	3	.85	.27	0	2.55	**Smart Phone (SP) WWW Brower (Hours per week)**
Mobile Navigation (Hours per week)	16	0	.7	.15	11.2	**SP GPS/ Mapping (Hours per week)**
Mobile Search (Hours per week)	4	.64	0 .36	.60	2.4	**SP Intelligent Assistant (Hours per week)**

Phase I - Pre Product Introduction: Proto Value
Distance: Smart Phone Platform Example

$D_{i,j}$ = The distance-barrier is in general a matrix that defines the cost required for any product feature "k" to satisfy a need type "i"

Distance is the time required to locate (search cost), acquire (acquisition cost), learn how to implement (learning time cost), and infrastructure use (support and maintenance costs) for a general product solution and a particular product feature set.

Cost (days 0 – 30) / days 31-60	Vector 1: iPhone Map App (Navigate)	Vector 2: : iPhone Siri App (Search)	Vector 3: : iPhone Safari Web Browser (Browse)
Search (Locate Product)		1 hour / 0 hours	
Acquisition		1.25 hours / 1.25 hours	
Use Cost (Device)	1 hour / .1 hours	.5 hour / .1 hours	.5 hour / .1 hours
Use Cost (Service Provider)		1.5hours / 1.5 hours	

Assumption: Acquisition and Use Costs in hours can be calculated using an average hourly wage of $$26.22 (US Department of Labor – Bureau of Labor Statistics May 2017). As an example an $800 Smart Phone would equal approximately 31 hours acquisition cost. Consider that most phones sold are bundled with cellular / data services and are charged out in a monthly basis over a 24 month contract.
For a typical product feature set, distance is estimated for the first 30 days of use and then again for next 30 days of use to account for adjustments in search and acquisition costs.

Phase I - Pre Product Introduction: Proto Value Calculating Protovalue: Smart Phone Platform Example

Proto Value Matrix Calculation $= \Sigma_{i,j,k} n_i \bullet (H_{i,j} \bullet F_{j,k}) / D_{ik} \bullet f_k$

Where:

(Consumer Mass) n_i = need vector components
(Fit) $H_{i,j}$ = the need to solution space fitness fit matrix normalized for Distance
(Fit) $F_{j,k}$ = the product feature to solution space fit matrix normalized for Distance
(Product Mass) $f_{j,k}$ = the product feature vector component
nv = Need vector
gpsv = General Product Solution vector
d = Distance for each General Solution vector

Consumer Need Navigation x hours	nv1 * pgsv1 /d1 nv1 * gpsv2 /d1 nv1 * gpsv3/d1	Gen. Product Sol Navigation x hours
Consumer Need Search x hours	nv2 * pgsv1 /d2 nv2 * gpsv2 /d2 nv2 * gpsv3/d2	Gen. Product Sol. Search x hours
Consumer Need Browse x hours	nv3 *gpgsv1 /d3 nv3 * gpsv2 /d3 nv3 * gpsv3/d3	Gen. Product Sol. Browse x hours

Phase I - Pre Product Introduction: Proto Value Calculating Protovalue: Smart Phone Platform Example

Proto Value Matrix Calculation $= \Sigma_{i,j,k} n_i \bullet (H_{i,j} \bullet F_{j,k}) / D_{ik} \bullet f_k$

Consumer Need Browsing (1) x hours	nv1 * pgsv1 /d1 nv1 * gpsv2 /d1 nv1 * gpsv3/d1	Gen. Product Sol Navigation x hours
Consumer Need Navigation (v2) x hours	nv2 * pgsv1 /d2 nv2 * gpsv2 /d2 nv2 * gpsv3/d2	Gen. Product Sol. Search x hours
Consumer Need Search (3) x hours	nv3 *gpgsv1 /d3 nv3 * gpsv2 /d3 nv3 * gpsv3/d3	Gen. Product Sol. Browse x hours

(Vector 1) Browsing: ***2.55 hours * (3*.85/4.25) + (16*.27/4.25) + (4*0/4.25)*** **= 4.13 Proto-value (PE)**
(Vector 2) Navigation : ***11.2 hours * (3*0/4.75) + (16*.7/4.75) + (4*.15/4.75)*** **= 27.85 Proto-value (PE)**
(Vector 3) Search: ***2.4 hours * (3*.64/4.25) + (16*.36/4.25) + (4*.60/4.25)*** **= 5.68 Proto-value (PE)**
Total Product Pre-Introduction Proto-Value Day 0 - 30 = 37.66 Proto-value (PE)

Assumption: The General Product Solution vectors represent an idealized General Product Solution space and can be mapped directly to a particular customer need space. The actual product feature set space is transformed and mapped, using a fit matrix, to the General Product Solution Space.

Phase II – Innovator Purchase and Use: Exchange
Actual Use: Smart Phone Platform Example

Innovator actual use generates Work Value (WV) or Kinetic Energy. This newly generated WV is used to calculate PV when the Customer Use vectors are adjusted for actual use. When innovator WV, or KE, is greater or less than Pre-Product Introduction PE then the level of Action is expected to increase or decrease the resulting activity or adoption rate.

Protovalue Calculation: Innovator Point of Sale

(Vector 1) Browsing: *2.55 hours * (3*.85/4.25) + (16*.27/4.25) + (4*0/4.25* **)= 4.131 Proto-value (PE)**
(Vector 2) Navigation : *11.2 hours * (3*0/4.75) + (16*.7/4.75) + (4*.15/4.75)* **= 27.85 Proto-value (PE)**
(Vector 3) Search: *2.4 hours * (3*.64/4.25) + (16*.36/4.25) + (4*.60/4.25)***= 5.7 Proto-value (PE)**

Total Product Pre-Introduction Proto-Value Day 0 - 30 = 37.66 Proto-value (PE)

Protovalue Calculation: Innovator Actual Use

(Vector 1) Browsing: *2.55 hours * (3*.85/4.25) + (24*.27/4.25) + (6*0/4.25)* **= 5.42 Proto-value (KE))**
(Vector 2) Navigation : *11.2 hours * (3*0/4.75) + 24*.7/4.75) + (6*.15/4.75)* **= *41.*.77 Proto-value (KE))**
(Vector 3) Search: *2.4 hours * (3*.64/4.25) + (24*.36/4.25) + (6*.60/4.25)* **= 5.95 Proto-value (KE))**

Total Product Pre-Introduction Proto-Value Day 0 - 30 = 53.68 Proto-value (KE)

In this example, innovator actual use (KE) of Navigation and Search was higher than expected use at Point of Sale or PE and would result in higher energy and resulting action over time.
ΔA = Δ (PE + KE) * Δ Time

Phase II – Innovator Purchase and Use: Exchange
Point of Sale: Smart Phone Platform Example

During Phase II – "Innovator Acquisition and Use", the level of activity or action can be predicted based on a change in perceived value or Proto-Value (PV) which results from an exchange.

- **PV[C, P]** = value customer assigns to the ownership of the Smart Phone
- **PV[C, M]** = value customer assigns to the ownership of his money
- **PV[B, P]** = value the business assigns to the ownership of a Smart Phone
- **PV[B, M]** = value the business assigns to the ownership of the customers money

The potential energy (protovalue) before the exchange is

$$PV_{before} = PV[C, M] + PV[B, P] = 37.66 * 2 = 75.32$$

The potential energy after the exchange is

$$PV_{after} = PV[C,P] + PV[B,M] = 100+75.32 = 175.32$$ **(We added 100 with the general assumption that the customer and the producer believes that they are better off by 50 more units of Protovalue)**

The change in potential energy if the exchange happens is

$$PVx = Pv_{after} (175.32) - Pv_{before} (75.32)$$
$$PVx = 100$$

The more PV generated by an exchange the faster the exchange happens..

$$\Delta A / PVx = \Delta Tx$$

Assumption: At the Point of Sale we consider Proto Value as Potential Energy from the Physics Analogy. This is due to the fact that the customer has not yet used the product and thus no Work Value or Kinetic Energy has been generated.

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Phase III – Imitator Purchase and Use: Exchange Point of Sale: Smart Phone Platform Example

Imitator Point of Sale PV or PE considers how unevenly distributed actual innovator use of general product solution space vectors, or observed change in KE, moderates imitator customer need vectors and resulting PV or PE.

Protovalue Calculation: Innovator Actual Use

(Vector 1) Browsing: *2.55 hours * (3*.85/4.25) + (**24***.27/4.25) + (**6***0/4.25)* **= 5.42 Proto-value (KE))**

(Vector 2) Navigation : *11.2 hours * (3*0/4.75) + (**2**4*.7/4.75) + (**6***.15/4.75)* **= *41.*77 Proto-value (KE))**

(Vector 3) Search: *2.4 hours * (3*.64/4.25) + (**2**4*.36/4.25) + (**6***.60/4.25)* **= 5.95 Proto-value (KE))**

Total Product Pre-Introduction Proto-Value Day 0 - 30 = 53.68 Proto-value (KE)

In this example, innovator actual use (KE) of **Navigation (24 hours KE versus 16 hours PE) and Search (6 hours KE versus 4 hours PE)** determines the customer vector lengths in hours for imitator Point of Sale.

Protovalue Calculation: Imitator Point of Sale

Total Product Pre-Introduction Proto-Value Day 0 - 30 = 53.68 Proto-value (KE)

Assumption: For this example we assume that no changes in product features and resulting changes in General Product Solution space vectors were made after observing actual use. In many cases a producer will make additional investment in a product feature set that seek to reduce distance based on observed innovators behaviors and feedback

Phase III – Imitator Purchase and Use: Exchange Point of Sale: Smart Phone Platform Example

During Phase III – "Imitator Acquisition and Use", the level of activity or action can be predicted based on a change in perceived value or Proto-Value (PV) which results from an exchange.

- **PV[C, P]** = value customer assigns to the ownership of the Smart Phone
- **PV[C, M]** = value customer assigns to the ownership of his money
- **PV[B, P]** = value the business assigns to the ownership of a Smart Phone
- **PV[B, M]** = value the business assigns to the ownership of the customers money

The potential energy (protovalue) before the exchange is

$$PV_{before} = PV[C, M] = 53.68 + PV[B, P] = 53.68$$

The potential energy after the exchange is

$$PV_{after} = PV[C,P] = 91.18 + PV[B,M] = 91.18$$

The change in potential energy if the exchange happens is

$$PVx = Pv_{after} (182.36) - Pv_{before} (107.36)$$

$$PVx = 75$$

The more PV generated by an exchange the faster the exchange happens..

$$\Delta A / PVx = \Delta Tx$$

Assumption: At the Point of Sale for the imitator customer segment we consider imitator actual use, or kinetic energy, when determining PV before the exchange. PV after the exchange is the result of innovator influence on imitator perceived value of PVx for a given product solution space.

Diagram 1: Calculating Proto Value: MPesa Case

Physics Analogy Equation for PE $PE = \Sigma_{i,j} \frac{mj \cdot Gji \cdot Mi}{Rji}$

Proto Value Matrix Calculation $PV = \Sigma_{i,j} \frac{n_i \cdot H_{ij} \cdot s_j}{D} = \Sigma_{i,j,k} n_i \bullet H_{i,j} \bullet F_{j,k} \bullet f_k / D_{ik}$