

MEC442 - Innovation Management Notes

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I. INNOVATION IN FIRMS

A. Week 1: Definitions, Dimensions, Degrees, Drivers

1) Innovation Definitions:

Schumpeter, Porter and Rogers all offer different definitions of innovation, all of these definitions use the word new but in different ways, interestingly Rogers specifically defines the perception of something being new as peoples perception plays a big role in what they define as innovative. Porter on the other hand emphasises that innovation can just as easily be from other business departments than just R&D explaining that business process innovations can be just as profitable.

2) Innovation Dimensions:

- 1) Product Innovation - The innovation of a new or improved produce is an obvious innovation but as soon as the product is publicised other companies can start producing cheaper or higher margin versions of the product. The leap-frog effect is also an issue here where competitors, large or small, can overtake the innovation such as innovating a 3 blade razor to a 4 blade razor can be leap-frogged to 5 blade etc.
- 2) Process innovation - The innovation of how a product is manufactured allows a product to be made more cost effective or design complexly manufactured meaning copycats can't work as easily.
- 3) Service Innovation - Service innovation is where add-on services differentiate a product such as: product support for a system, sensor data systems such as Siemens Mindsphere.
- 4) Business Process Innovation - Business process innovation is where a supplier can offer a product in a different manner such as online shopping or delivery to your door subscriptions.
- 5) Business Model Innovation - Business model innovation is where value can be made by capturing a new market such as BMW creating a car share platform.

Other dimensions such as Packaging or Design can also become innovative such as Apples sleek and professional designs (This is also linked closely to product innovation but the product itself may stay the same internally but sold in different designs such as iPhones in well thought packaging).

3) Innovation Degrees:

- 1) Incremental - This is innovation dedicated to improvements to existing products, these innovations are usually easy to predict based on customer complaints/desires such as more eco-friendly washing machines or fridges.
- 2) Breakthrough - Breakthrough innovation is where an entirely new product design is created, these are usually much harder to predict as they are completely different systems which work in different ways and the market may not be used to.
- 3) Radical - This is a product that is for a market that doesn't yet exist such as subscription music by ITunes. These innovations are very hard to invent given no

current customer to target and even harder to succeed in market delivery.

The amount of money funded to these degrees of innovation change company to company depending on their market, business model and product but generally follow what's called the Golden ratio 70-20-10 respectively.

The harder each of these degrees are to succeed in, the easier it usually is to market and sell these innovative ideas given these innovations have no competitor yet.

4) Innovation Drivers:

- 1) Technological Advances - Things such as the internet or engines, difficult to keep on top of (Open innovation, see week 7)
- 2) Changing customers and needs - Ageing population with higher earnings (Frugal innovation see week 8)
- 3) Changing Business environment - Brexit, regulation changes, business cycles
- 4) Intensified competition - Containerisation, unexpected entrants
- 5) Strategic intent - How much the company wants to grow and innovate. This is the only internal driver.

B. Week 2: Processes, Pentathlon Framework

1) Dominant design: When different solutions are offered, over time one design tends to become dominant or a de-facto standard such as QWERTY keyboard or VHS tapes. This may happen due to multiple reasons:

- Best function - Simply one performs better in some desirable metric.
- Threshold effects - For someone to change from the currently learned standard would take a reasonable habit change or effort.
- Network effect - Where many people using a service increases its quality such as the internet or online game/social media.

Once a dominant design is created innovation tends to slow for many reasons and focus drifts into innovating the price/process of the design to increase profit or market. This gain tends to drift after depleted, this time into brand innovation to make sure that the brand is recognised as the standard and maintains a monopoly as shown below.

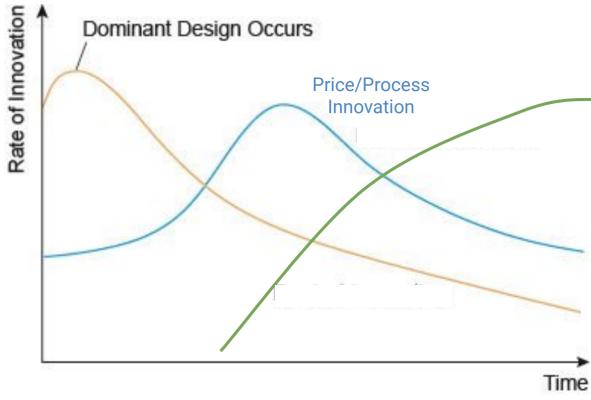


Fig. 1. Dominant design innovation over time

2) *Diffusion of Innovations*: Some people will buy products as soon as announced if attracted by the novelty and sold on the function. Others will wait until the product is proven by others and some will only adopt new things once it is required bringing rise to the adoption life cycle seen below:

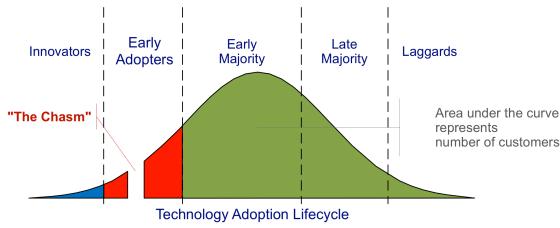


Fig. 2. The Adoption life cycle seen in "Diffusion of Innovations" by Everett Rogers

Although this may follow a standard deviation style curve, there is no association and putting numbers to these regions, as many do, is even more deceptive.

There are 6 defined stages in the adoption life cycle:

- 1) Innovators - Innovators are people who are interested in a product given the technology or perceived novelty of the product. These people are more tolerant to issues with a product and usually willing to pay more.
- 2) Early Adopters - Early adopters are interested in the product from their own intuition and don't rely on others to persuade them of the product. This is commonly due to a perceived edge early adopters believe the product will give them. By this point the product has worked out some kinks but isn't perfect and is starting to rise in popularity.
- 3) The Chasm - The chasm is the death point of most products, here the product can struggle to meet the main market as early adopters aren't publicly expressing the product and thus has little pushing power into a majority market.
- 4) Early Majority - The early majority are a large portion of the market that take up the product after the main hurdles

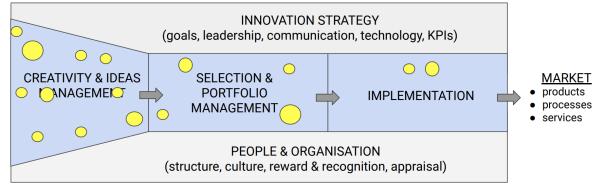


Fig. 3. Innovation Pentathlon

are overcome and the product is ready for everyone to use.

- 5) Late Majority - The late majority are another large portion of the market but this market purchase the product after success in the early majority based on opinion or seeing the product in use already.
- 6) Laggards - Laggards are the last step of the market where people who are behind on technology or only need the product as it's standard start to purchase the device. Here the users likely aren't likely to spend much willingly.

Many factors influence how well a product takes off namely:

- Advantage - Does the product have an obvious advantage over the previous
- Benefits - Does the product have obvious benefits.
- Trial - Can the user test it first?
- Compatible - Can the product be introduced easily/streamlined.
- Complex - Is the product complex?
- Risk - Does the product bring any risk?

3) Business functions:

- R&D - Drives product ideas.
- Marketing - Identifies customer needs.
- Design - Form and function design.
- Sales - Customer knowledge and service innovation.
- Operations - Long term advantage.
- Finance - Business selection .
- Human Resources - Company culture support.
- Leadership - Setting company tone/culture.

Ideas for innovation can be seen as a funnel system where ideas are put in and joined/filtered into good and worthy ideas exiting to be pursued.

4) Innovation pentathlon:

- Creativity - The fuel for innovation is ideas and as such the business must promote an environment where ideas can thrive.
- Selection - Selection must be completed as not all ideas can be funded or will bring a profit. Big winner ideas aren't always the best due to the high risk involved.
- Implementation - This stage is based around effectively developing ideas, this can be accelerated through testing and well made teams.
- Innovation strategy - Innovation strategy depends on managers grasp on external market changes. Systems and resources must be selectively picked for optimal idea development. KPIs must be used to track this.

- People and Organisation - Company values, the people you hire, roles, team structure and culture. All important for idea development keeping teams working well.

This model shows how Innovation strategy and the people/organisational culture form the development of ideas onto the market, not by predicting but by a system diagram that can be used to troubleshoot teamwork showing how all components are joined.

II. BEING AND INNOVATOR

A. Week 3: Innovation Strategy

1) Innovation Strategy element of the Pentathlon Framework: Innovation strategy, as seen at the top of Figure 3, is driven by the drivers seen in I-A4 where the company knows it must change to meet demand being driven by where the company is vs where the company wants to be in the future. This innovation strategy shapes the rest of the pentathlon as ideas will be formed and judged against the company's desired strategy.

2) Tools for strategic analysis: Innovation strategy requires the ability to predict the future markets and threats, this is a difficult thing to do without a methodology. Significant strategies, such as target market changes, can take decades of planned strategy. This means there is uncertainty in the strategy plan proportional to many variables and must be planned around this uncertainty. Generally uncertainty can be split into four categories:

- Clear future - Future looks clear, the main uncertainty is around the impact of innovation.
- Alternative futures - Definitive few futures such as brexit or non-brexit.
- Range of futures - Lots of futures but still definitive such as how electric vehicles will deal in the market.
- True Ambiguity - Too many variables to realistically iterate over futures such as the Russian market after the fall of communism.

There are two different techniques of strategic analysis that will be discussed each with their own advantages and disadvantages and therefore use cases.

1) Scenario Planning

Scenario planning is a tool first used by Shell to predict the market after WWII. This is used for scenarios with alternative futures but not a range of futures. Although there are alternative futures, normal market rules such as supply and demand/cause and effect still apply such as an increase of personal cars reduces need for taxis. The idea of scenario planning is to understand all of the different possible outcomes and use this information to, ideally, create a plan that will work well in all scenarios or, at least, avoid scenarios that will be disastrous in some futures.

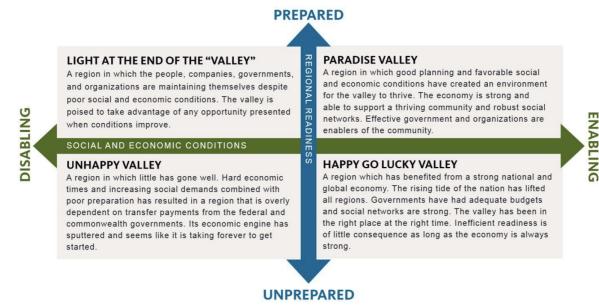


Fig. 4. An example of scenario planning for Long Range Transportation Plans in Roanoke Valley VA.

As seen in Figure: 4, a scenario plan consists of two axis of which are decided upon depending on the situation from bad to good, this then makes up four quadrants each usually defined a descriptive yet cryptic name for the scenario. The job of the planner is to foresee what would happen in each of these four quadrants and thus make a plan from these to drive the company. The steps of generating a scenario plan usually look like this:

- Identify the issues of concern and timescale of interest.
- Analyse all internal and external forces at work and identify assumptions that apply to all.
- Identify the variables that define your environment.
- Extrapolate the variable to the timescale to make your boundaries.
- Consider all possible combinations of the key factors. Reject any combinations that are incompatible or contradictory.
- Analyse the remaining scenarios in depth and suggest actions.

2) Technology Roadmapping

Technology roadmapping is a technique first developed by Motorola and Corning in the 1980s. A roadmap shows what a companies goals are, how it will meet them and what resources are needed to meet that. Roadmaps are usually live documents ever changing compared to a fixed design. It can be seen as a more complex gantt chart, showing more than just tasks over time. As such roadmaps always have the X axis as time, on the Y axis there tends to be at least four different aligned channels:

- Know-when (timing)
- Know-why (aims)
- Know-what (deliverables)
- Know-how (capabilities)

These tend to change to suit the project applied to. Due to the amount of different knowledge needed generating a roadmap is usually collaborative. A generic roadmap can be seen below:

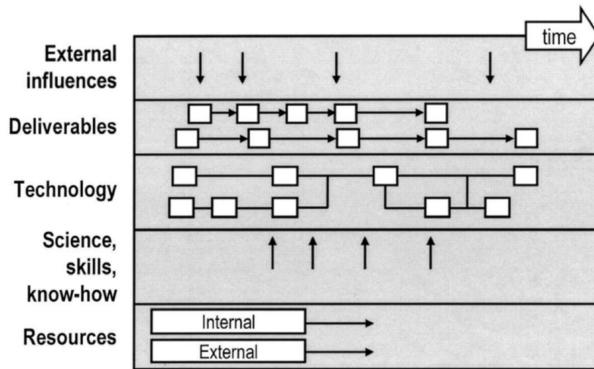


Fig. 5. An example of a typical technology roadmap layout

3) Understanding customer satisfaction through feature analysis: To understand where the market is headed, understanding what customers want and enjoy is key, to do this we discuss Kano's Feature Analysis with two main ideas, feature fatigue (too many features can be detrimental) and capability ceilings (Can't viably incrementally improve the product more). Generally features can be broken down into three main groups:

- Basic features - Features required for a sold product (unacceptable without)
- Performance features - Features that offer an improvement (usually leapfrog style innovations such as higher efficiency or lifespan)
- Excitement features ("Delighters") - Delighters are often responses to hidden needs aka things customers don't realise they want such as the first remote control TV.

The Kano feature diagram, seen below, shows how customer satisfaction varies with implementation of the different features.

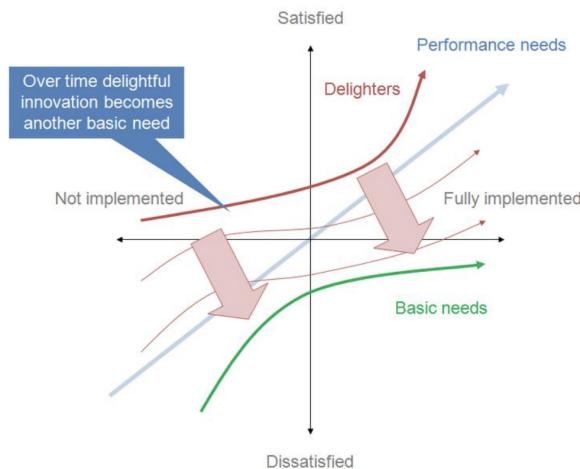


Fig. 6. The typical Kano satisfaction graph over feature implementation.

As much as companies want to push delighters, performance and basic needs to the max to have the ultimate product there are a couple issues, the first of which is the capability ceiling.

A capability ceiling is the physical limit that a technology can be pushed to before being saturated of all good innovations, after this point the product is stagnant and in terms of the company you product will likely start dropping in popularity for alternatives which is a large red bell moment. The generic ceiling S curve can be seen below:

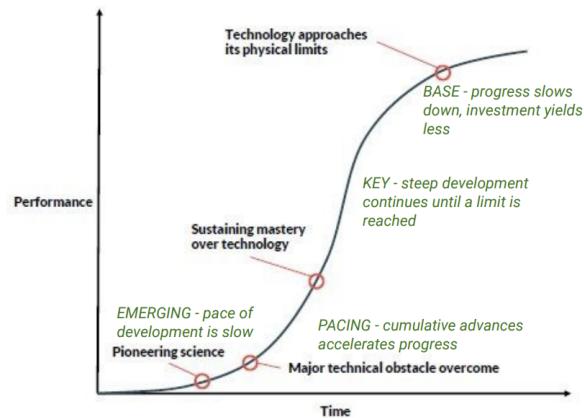


Fig. 7. A usual capability ceiling S-curve showing innovations on technology over time.

From this we can pull of a few strategies for companies planning innovation. Ideally after emerging and developing a technology focus should be on improving performance features pushing the technology. More importantly as a company pushes the technology towards the plateau of the curve more emerging technologies should be researched ready for a new innovative product before phasing out the previous.

In most innovation areas, such as hotels, one product isn't distinctly better than another and instead some features are better and some worse. This difference in offerings targets your audience and market such as high end expensive hotels that excel in all areas but cost an arm and a leg have a large feature differentiation to a cheap Travelodge but this doesn't make either distinctly better or worse as both have their markets. A good example of this can be seen in Figure:???. This leads to a few strategies for formulating a successful business in a tight rivalrous market:

- Look for ideas from other segments of the market and combine the most attractive features of both, eliminating the other features.
- Look across to their industries that fulfill a similar function in a different way
- Target a different part of the buyer chain
- Offer a different mix of emotional and functional needs
- Consider accompanying consumables and service

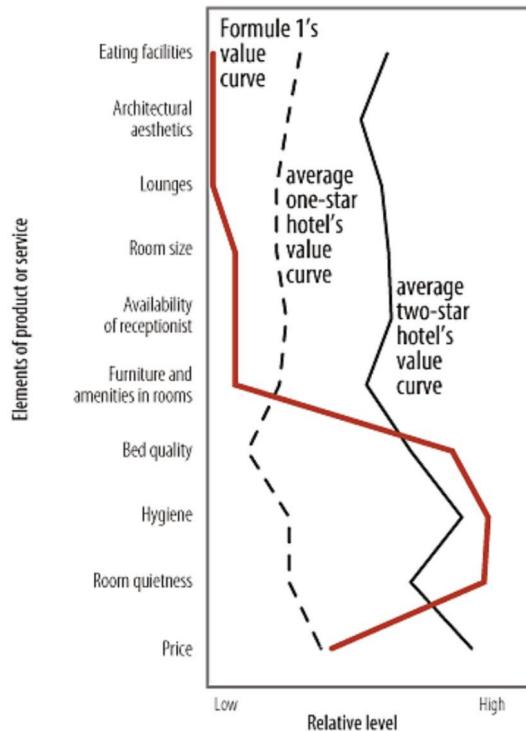


Fig. 8. A chart showing how Hotel Formule 1 differentiates its services to target its market well.

Another issue for innovation strategy is the fact that the delighters and performance features loose their novelty over time and become basic needs again relating to the remote controlled TV, this is now an expectation of most consumer TVs.

4) *Technology limits and disruptive technologies:* Disruptive technologies occur when a performance feature becomes a basic feature such as mobile phones disrupting the original landline phones, this usually leads to one market leader such as the iPhone for smart phones. The graph below shows disruptive technologies advancement.

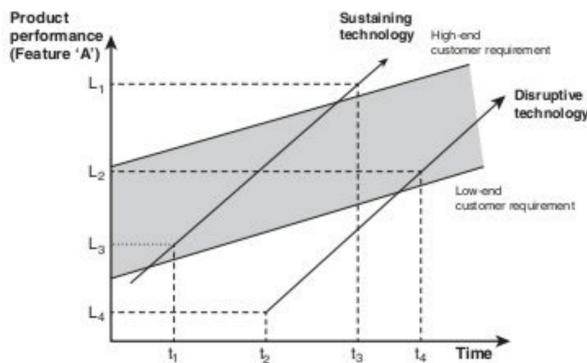


Fig. 9. Disruptive technology graph

In Figure: 9, the rate at which a technology increases is greater than that of the market(shaded grey). Once the market

leader innovates the product too much and offers too many services at a higher cost, customers who only require or can use less features are more likely to buy another product that's cheaper but from a less advanced supplier. This can be seen where older generations buy cheap mobile phones for tens of pounds because all they require is to send and receive calls versus the thousand pound phones being lead by innovative companies leaving a large market open for smaller disruptive companies to capture.

B. Week 4: Innovative ideas and selection

1) *Where ideas come from and creativity myths:* Ideas come from many places mainly from trying to meet the needs of the customer, this however isn't ideal given customers don't always know what they want. Ideas also commonly come from outside the organisation in free time or company time experiences. These ideas can be incremental, breakthrough or radical where more growth comes from radical and breakthrough innovations. Well managed companies create a product from every 5 input ideas with badly managed companies one in 12. Innovation can be with regards to products, processes, services and business models. An environment where ideas can be generated and tested are key where diversity of knowledge is key. The filtering of these ideas is key, false positives and false negatives must be reduced but managed to stop bad ideas progressing but arguably more important stop good ideas being blocked. Commonly creativity is said to be unmanageable as you can't force it, however you can certainly create uncreative environments that must be avoided for an innovation centric business. Another is that innovation is only about thinking outside the box which is again not the way to stimulate or expect innovation. There are three main types of creativity:

- 1) Creativity through Exploring
Innovation through studying and questioning current ideas and processes.
- 2) Creativity through Problem-Solving
Innovation through solving well defined customer or market issues.
- 3) Creativity through Luck
Innovation through lucky ideas.

2) *Supporting creativity in individuals and groups:* Individuals sometimes need to have their creativity managed, managers must motivate staff and allow transfer of knowledge, forming teams of similar personalities to allow forming and norming of teams but diverse enough to allow complex and varied ideas to be generated.

Groups are involved in almost all innovations after forming an idea and supporting this is key. Diverse teams help create varied ideas but these teams need to be formed around the problem with enough freedom to try new innovative ideas but still require a well defined problem. Enough but not too much time and money need be allocated or the program will risk too much or be choked by the business. Many tools are available to support creativity, some better than others but always a time and place for each. The commonly known and used method of "Brainstorming" takes advantage of freedom

of ideas from many different people each stimulating their own ideas off. This method can however leave people tunnel visioned sometimes if badly managed and a lack of diversity used. Attribute analysis is another method where products can be innovated by questioning the current products, modified, multiplied, divided, subtracted or unified. Creativity can be stimulated by looking at developing and emerging markets for their difference in needs and business but also methods of cost cutting and making barebones products that meet demand and can be a disruptive technology. Biomimicry is another method of stimulus by looking at how evolution has allowed systems to thrive such as long distance communication by birds or ergonomics of products.

3) *Project selection & portfolio management:* Selection is usually a rolling process where projects and innovations are dropped based on success compared to a definitive step. A company's portfolio is a high-level view of current projects and selection of innovation must be appropriate otherwise poor project selection process can lead to delayed projects, late-to-market, increased costs, low staff morale, low profitability, lost opportunities, badly allocated resources, overstretched management attention. To select projects a few steps are taken, value must be perceived by the organisation, project risk should be balanced aka not all current projects are high risk, the project must also align with the company's strategic intent. Formal steps of evaluation through non-financial evaluation checking the general validity of the idea, company specific criteria where meeting business plans, a commercial focus of the project is taken to plan profits, a formal business plan is generated planning break-even points and net present value. Project evaluation techniques such as stage-gates where definitive points of agreed criteria are checked. Quantified decision trees define profits vs outcomes aka loss in failure vs profits in successes. Monte carlo analysis planning chance of completion. These are usually based on financial methods which is usually very hard to plan at such an early project point, instead methods need to take more data into consideration. Most commonly for low level projects intuition is used where someone/people judges the innovation and purely based on existing innovations define good or bad ideas, unfortunately it's hard to quantify intuition and also on breakthrough or incremental innovations. Multi-criteria decision analysis (MCDA) is a formalised selection methodology where many criteria are scored taking in as many different ideas as possible to compare.

C. Week 5: People and organisation

1) *How do we manage culture and change to support innovation?:* Different cultures work better in different scenarios and the people and organisation must be set around this to drive a healthy innovation environment.

- Fuzzy front end
 - Openness
 - Risk-taking
 - Effective reward/recognition
 - No-blame culture

- Innovation strategy
 - Leadership must set a clear strategy;
 - Organisational structure should support innovation
- Selection
 - Good team ethos
- Implementation
 - Good implementation comes from teams
 - Cross-functional working
 - Motivating leaders
 - Project-to-project learning

Organisational culture is probably the largest driver a business can decide to form how most employees work. It is understood to be the set of values, understandings and ways of thinking that is shared by the majority of members of an organisation, and that is taught to new employees. There are many attributes that effect a company culture, one for driving innovation will likely use many of the below table:

Customer-centric	<ul style="list-style-type: none"> • Really wants to serve customer needs • Employees trained in identifying customer needs 	
Open to new ideas	<ul style="list-style-type: none"> • Part of company values • Implement high levels of trust 	<ul style="list-style-type: none"> • Do not overuse control • Encourage constant experimentation
Effective cross-functional teams	<ul style="list-style-type: none"> • Recruit and work with creative people • Build collaborative and diverse teams • Bring together members from different functions 	<ul style="list-style-type: none"> • Protect time for innovation • Build effective communications • Create communities of interest
Well-defined processes	<ul style="list-style-type: none"> • Have ways to generate ideas • Make idea selection focused on growth (not costs) • Flexible (but fast) implementation processes 	
Risk tolerant	<ul style="list-style-type: none"> • Actively avoid risk aversion • Focus on learning rather than blame 	
Supportive reward and recognition	<ul style="list-style-type: none"> • Provide opportunity to join challenging projects • Give full and regular recognition • Have appropriate rewards 	
Appropriate leadership	<ul style="list-style-type: none"> • Provide a clear vision on why and how innovation is important • Set clear boundaries and select structure 	<ul style="list-style-type: none"> • Show high-level sponsorship and participation • Give a commitment to innovation in terms of time

Fig. 10. Many key points for a healthy company innovation culture

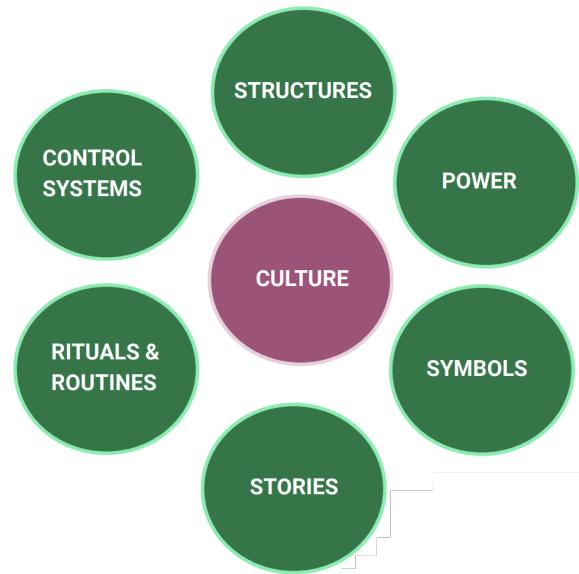


Fig. 11. An example generic culture web showing all different drivers of culture (Johnson and Scholes)

2) *The culture web:*

- Structures

Organisational structure drives how companies operate given this structure tends to dictate how teams are formed and who reports to who and thus the team drivers.

To target structure around innovation steps such as re-organisations and innovation managers may be implemented.

- Power

Power is somewhat driven by the organogram but also others such as a department being perceived or is more powerful than others such as quality in pharmaceuticals. Other things also drive power such as perceived experience or leading an important product/department.

Cross functional teams disrupts and experience based power and creates an innovation centric team. Constructive criticism and kaizen (constant improvement) help drive well designed innovation scenarios.

- Symbols

Company symbols almost always have logos, even these logos drive what is expected from the company. Things such as office sizes, dress codes and wall adverts drive what people should be thinking and acting.

Product displays showing past products and even failures including plaques helps drive innovation desire.

- Stories

Company stories often told when recruiting often sets definitive morals and company culture.

Anecdotes of innovation and what's currently happening in terms of company innovations.

- Rituals & Routines

Company standard order procedures drive how employees should go about normal operations which drives how people should think about company processes. Other unwritten procedures drive how people perceive the company and thus its rules. Rituals such as meetings and programs drive the same perceptions and default structures.

Making funding available for innovative projects and methods of introducing innovation or questioning current procedures.

- Control systems

Management control systems are direct targets for employees to target such as key performance indicators and objectives. The method in which these are measured and rewarded drive how, why and if these objectives are met. Defining budgets towards supporting innovation is useful to prototype good innovations.

An important way to boost innovation is through new recruits bringing new technical knowledge, psychometric tests are used to test new talents alignment to the company morals and vision. True innovators are rare but when developed bring huge positive impact to the company so developing, nurturing holding onto that talent is important. The 'ideal' innovator will have technical competence, cross-functional skills, be persuasive/champion their ideas, and be motivated to the task.

3) *Managing change:* Changing the organisation means changing peoples mindsets which can be difficult, resistive

and slow. Many models are made and available:

- Tushmans change principle (D>V>P>C)
 - D: (Current situation dissatisfaction)
 - V: (Vision, how well planned and well resulting is it)
 - P: (Convincing process)
 - C: (Cost of change, not just monetarily)

- Lewin's change model

- 1) Unfreeze - Dealing with current ways of working, making sure there is infrastructure and support for change.
- 2) Change - Implement the changes needed.
- 3) Refreeze - Ensure these changes are sustained and continued.

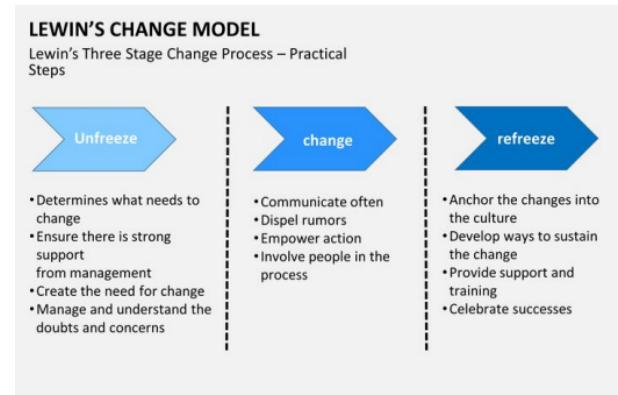


Fig. 12. Lewins change model

4) *What makes an effective innovation leader:* What the leader needs to do:

- Setting the innovation strategy
- Communication of strategy
- Develop an innovative environment to thrive

Allow for breakthrough and radical innovation:

- Standard procedures don't allow for breakthrough and radical
- Leader needs to be open to unconventional ideas.
- Open to novel organisation structures to develop innovation

Ideal leader:

- Questioning, observant, connects the facts
- Accepting of ambiguity: Understand the tradeoffs between: individuals vs teams, support vs confrontation, patient vs communicating urgency, leading from the top vs stimulating bottom-up

D. Week 6: *Implementation: Projects and teams*

Turning ideas into reality:

- 1) Overcome resistance - As mentioned in managing change above

- 2) Project management and risk management - Detailed implementation and management structure of the project whilst reducing risks
 - 3) Team organisation - Structuring a team to bring the right skills and people together.
- 1) *Project management methodologies:* There are many management methodologies, four of the most popular are:
- 1) Staged/Sequential Models



Fig. 13. Simple sequential business model flow.

This is where each activity has a distinct start and finish always leading to the next. These formal sections allow for easy control of the project but can lead to a lack of communication and changing requirements or developments ignored given the fixed nature.

- 2) Cross-functional Models
- Cross functional models break up over-the-wall (idea of throwing the project between sections with no interaction) by having a distinct project leader managing all processes with team members all aware of the current project state allowing each member to have an input at any stage.
- If team members are removed from their departments, members can soon become ill-aligned with their department.
- 3) Agile Models

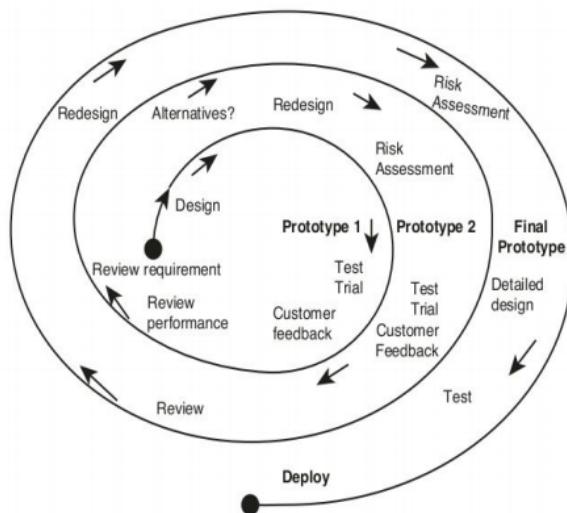


Fig. 14. Typical Agile model.

Agile methodologies aim to test the highest risk sections of the project first to reduce project cost in the case of a failure, this method also allows for parallel

working and pre-finished product releases for display. Agile methodologies are best used in high risk and low initial specification projects, difficult to implement in hardware expensive or safety critical projects, trial and error is much less applicable.

- 4) Scrum Models

Scrum models don't use project managers, instead scrum masters who delegate work and ensure a clean-operating system. The scrum model works using sprints of short but specifically deliverable items with the owner approving. This emphasises flexibility, communication and individual empowerment,

a) Choosing the right model:

- How much Specification is known from the start
- How modular are sections of the project
- Feasibility of prototypes
- Collaboration effective
- Team communication ease, can teams meet and communicate easily

b) Project management success:

- Clear aims and objectives
- Breakdown of work into manageable pieces
- A clear plan and schedule
- Resource plan, make sure resources are available
- Risk management, knowing and reducing the risks
- Staged review process, Look at what's going on
- Stakeholder management, yeah.. lots to say here

Innovative projects are usually much more uncertain given the un-common or currently un-practiced method (otherwise it's not innovative!)

- Showstopper risks - Hopefully projects with high showstopper risks are filtered out of the fuzzy front end. Such as not a viable product or undesired by the market.
- Pitfall Risks - Earlier work needing to be re-done, should be avoided by ordering projects in a useful order.
- Minor Risks - Small generic project risks, usually unpredictable to some degree but still need to be mitigated and monitored.

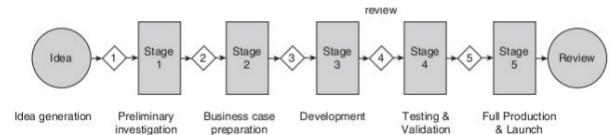


Fig. 15. Phase gate diagram

- c) Stage-Gates® (Phase-gates for no copyright infringement):* Stage-gates formalise the project review stages, defining when and what these reviews are for to make sure the project management is taking the right course with the project. More gates the more the project is under control but more time is spent reviewing and planning for reviews than progressing the project. At these review meetings, each part of the project is interrogated for progress and analysis such as documentation and finances. On top of this, the wider project is analysed

such as competitor progress, market state and supply. With this information the project is decided upon progression, small agreed changes or project stop.

d) Innovation failure: Innovation failure isn't bad, it's an opportunity to reflect on the failure and can lead to better and more innovation and improvement in project selection and generation. The most important step is stopping at the right time, don't kill projects with small issues and don't continue dead projects.

Sunk cost fallacy - We can't stop now there's too much time and money in the project. Team members may be demotivated and so the organisation must tolerate failure (not idiocy).

2) Team structures: Having well formed teams leads to a well oiled innovation machine. Many different team structures exist, each with advantages and disadvantages but all must work well within the organisation to be effective. Team structures influence formal relationships and organisation power but informal links. Many standard structures exist:

- Functional team

Functional teams are divided into teams based on their department, in this department they all work together for a common goal (Kaizen). In these teams innovation is rare given the lack of crossover, incremental innovation is the only likely innovation happening and this is likely departmental.

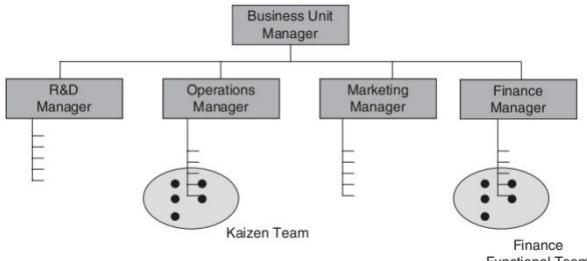


Fig. 16. Functional team.

- Cross-functional teams

More drastic innovation requires multiple perspectives and cross-functional teams allows for this. Cross functional team members still belong to their departments but are assigned to projects lead by a project leader (known as dotted line reporting). Cross functional teams allow for inter department working given team members across the department. One project manager is chosen, unfortunately the one departmental project manager will have different priorities than if the manager was from another department. These project managers are also of lower hierarchy than department managers which can lead to the projects being over-ruled by a department manager or team members taking work from managers more seriously.

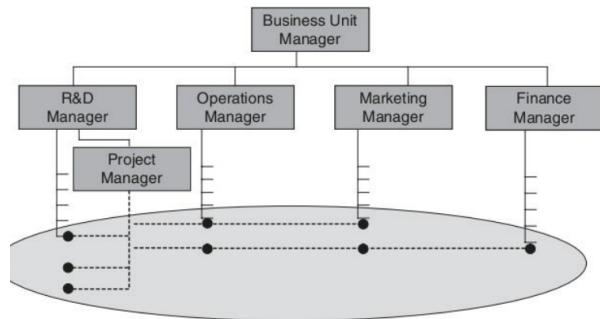


Fig. 17. Cross functional team.

- Heavyweight Cross-functional teams

heavyweight cross functional teams alleviates some of these problems by elevating the project manager to equal stature to managers, this removes any over-ruling or lack of formal control over team members. This also reduces the issue of departmental priorities as the manager does not belong to any department. (No dotted line control)

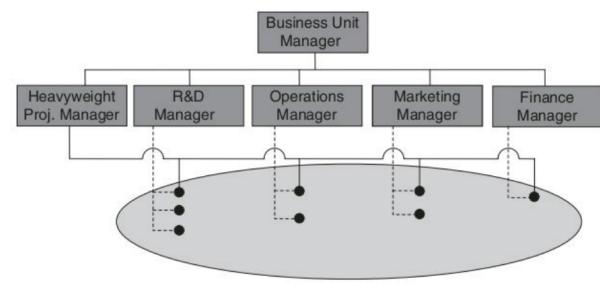


Fig. 18. Heavyweight Cross-functional team.

- Autonomous Teams

Autonomous teams aim to improve radical innovation by reducing standard departmental routine. Autonomous teams take the members out of their departments into full time teamwork with much more freedom. This separated innovation team allows for full freedom away from corporate bureaucracy and develop their own culture and strategy.

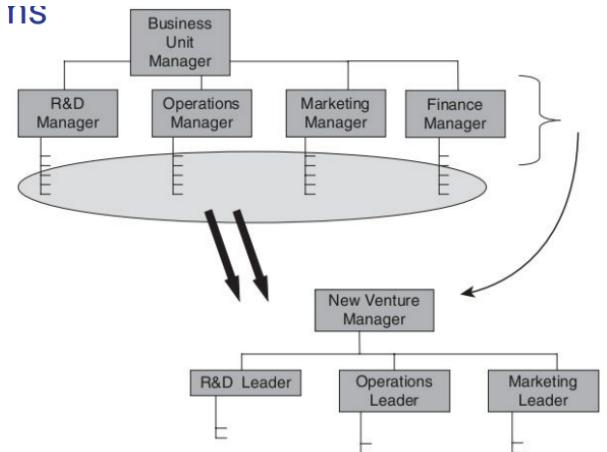


Fig. 19. Heavyweight Cross-functional team.

Skunk works is a name for a group within a company with freedom to work on advanced or secret projects. Invented by Lockheed Martin in 1943 to work on the US first fighter jet in 143 days.

• Virtual Teams

Virtual teams take team members from each department along with management support from an external source. Virtual teams work at long distances from each other meaning communication is much harder and must be managed. Virtual teams allow for collaboration between companies. The team is managed by the initiator company.

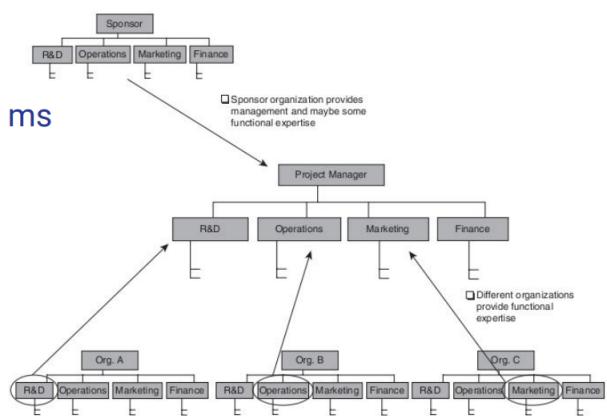


Fig. 20. Virtual team.

a) Managing functional interfaces: The wall between R&D, Marketing and Finance is very important, breaking down the barriers and improving mutual respect is important for clear working, managers and even team players must take lead on this by example and not being rude or going for cheap jabs. Despite this, well managed and friendly rivalry's can lead to innovative working and hard working teams always looking to increment on the other. Many simple steps can be followed:

- 1) Respect all team members' opinions and expertise

- 2) Don't compromise customer focus or quality without a team decision
- 3) Deliver work on time, or warn the team in advance if you expect problems
- 4) Communicate efficiently and always consider how you work impacts others
- 5) Question everything
- 6) Assess risk, but expect the unexpected
- 7) Make it a winning team

Improving physical and virtual teamwork is key:

When teams can be together, do (Helps communication and team spirit)

Communicate face to face where possible

Open plan offices allow for easy communication and interaction.

III. INNOVATION AS A SYSTEM

A. Week 7: Open Innovation

Open innovation, first described by Henry Chesbrough in 2003, consists of using ideas from outside the business along with allowing internal ideas out of the business with an aim of accelerating innovation in the sector. Open innovation is like having a permeable funnel in the innovation pentathlon letting ideas in and out. Open innovation has many implications:

- efficient and effective RD
- Challenges the need for the company to start all innovation of their products
- Requires the organisational culture to allow for such strategy
- Adds intellectual property and combination of innovation complexity.

There are a few key questions when implementing open innovation:

- how does it work practically
- How is open innovation implemented
- What structures, processes, rewards, control systems are required to benefit.
- Outweighing the costs of open innovation, Co-ordination, collaboration and reduction of partners taking opportunistic advantage of your company.

	Inbound (coming into the organisation)	Outbound (heading out of the organisation)
Based on money	Acquiring inventions and input to the innovation process through formal and informal relationships (sometimes, it can be easier to buy technology than develop it from scratch)	Licensing or selling technology in the marketplace (how companies commercialise their innovations)
Not based on money	Sourcing external ideas and knowledge from suppliers, customers, competitors, consultants, universities, public research organisations etc. (maybe a firm doesn't have a broad enough internal expertise/assets)	Revealing internal resources to the external environment (where can companies get value from diffusion, rather than commercialisation?)

Fig. 21. Aspects of open innovation

1) When does open innovation work?:

1) Not Invented Here Syndrome

Companies can worry based on previous times innovation has failed using external information. Managers can also find it hard to notice external factors to add value. Fears can be raised that working with external teams and companies will put jobs at risk and disrupt current workflow. Low skilled workers are most skeptical of open innovation

2) Skills and reward

Opening the innovation starts at the top of the organisation moving down to individuals. Doers in a company will need to work with new people, and may have less control and stakes in projects than previously. Changing the companies reward systems to account for these differences can help or hiring new collaborative staff.

3) Attention

Getting useful innovation into the company attention takes a lot of time and effort to find the useful information. Finding the best innovation is a tradeoff between accessing as many ideas as possible vs knowing each indepth enough and so requires a better fuzzy front end. An external intermediary can help develop these.

4) Compatibility

Important to have compatibility betewen the company and the outsider. Not only compatiblity of the solution to the problem but also the outsiders ways of working in both into and from the company. These compatability issues can be improved by additional solution adaptor stages such as manuals or toolkits to make the solution more applicable.

5) Who does the reaching out?

Better communication leads to better innovation. Does reaching out to external companies and building connections distance those employees from their company work? Overcoming issues by capturing all knowlege and development coming into the company.

6) Complimentary assets

Having assets available to commercialise innovation is key otherwise there is not reward for cultivating innovation. Having the ousider unavailable to commercialise reduces the possibility of IP loss. The larger the barrier to entry to a market, such as pharmaceutical, the larger the company to pair with needs to be.

7) Ownership

The legal basis of the innovation ownership is key to be set out beforehand to reduce any claims of breach of trust and make sure all parties are on the same level. Many times, conversation over innovation won't happen until the legal side is setout. Protecting against the paradox of disclosure, meaning your information is of zero value once shared but of zero value without sharing. Open design rejects the entire prospect of ownership.

8) Cumulative knowledge

strong science base, sharing knowledge is naturally incremental around improving of an innovation, allowing free speech to criticise and to build on ideas. Service

industrys havew much harder division of tasks. Fast moving technology can be hard to find partners.

9) types of technological advance

Existing companies specialise best in incremental innovation with external factors such as start-ups, investors or universities pushing more disruptive innovation. Making a good mix of open innovation leads to the desired golden ration of innovation.

10) Number of partners

Finding quality partners is key. Finding out why someone would partner with you is needed and then matching with a company needing your expertise with content and business structure. Intermediarys can be needed here. Need for being specific.

Current open innovation questions include

- 1) When is open innovation good?
- 2) Why are some firms better?
- 3) What needs to change between closed and open innovation
- 4) What competitive edged does it bring to your company

Open innovation is a good tool that needs to be managed accordingly to bring innovation into a company whilst developing the innovation as well as possible without detracting from the current company processes.

B. Week 8: Sustainable Innovation

Businesses exist to create value from resources, for higher profits these companies improve the value whilst reducing costs. All of these resources have environmental and social costs. This unforunately means companies aren't always driven to help these environmental and social concerns and relies upon governmental regulations to enforce change.

1) *What's changing:* Given the current environmental crisis things are changing:

- Firms are moving beyond compliance to internally control these environmental and social costs.
- Consumers are more aware of the environmental impact.
- More organisations are trying to protect and nurture public good.
- Some businesses are unsustainable (Petrol/Oil)

2) *Beyond compliance:* Companies choose to go beyond the compliance for many reasons:

- 1) Response to market demand
- 2) A cost advantage
- 3) Brand differentiation strategy
- 4) Upgrade products and processes
- 5) Building a green brand
- 6) Reduce cost of regulatory changes
- 7) maintain stakeholder relationships

3) *What that means for the companies:* this is leading to companies asking themselves many questions as to their impact and strategy.

- What are our externalities?

- Do these externalities require incremental innovation or something more radical and what does this mean for the business model.
- What parts of the company needs to change to allow for this environmental and social innovation.
- How to work with stakeholders to achieve this goal.
- Environmental leader or follower.

Many see sustainability as the sixth wave of human innovation. Established companies have well pre-defined markets and technology but can mean these companies are stuck in their ways. These changes can allow for a new company to enter the hollow space left and migrate up. Sustainability-led innovation forces the need to work with new technologies, new markets, new regulations.

4) Currently we are at a point where:

- 1) All businesses have social and environmental impacts.
- 2) It has been the governments job to enforce environmental standards.
- 3) Company collaborative standards sometimes seek to make the standards in their favor.
- 4) Companies have relied upon incremental innovation
- 5) Understanding that renewable innovation needs to become more radical.
- 6) Crisis of critical resources and environmental damage.
- 7) Companies, Consumers, Governments and technology all has a role.

5) Looking ahead: In the future companies are needing to have sustainability goals in the corporate strategy and requires long term strategy and goals. The innovation required is open and uncertain. Developing economies have an advantage of being able to adapt more than set in stone companies but a lack of pre-defined infrastructure.

6) Frugal innovation: Frugal innovation is the idea of innovating around a lack of resources. Places such as India do this a lot. There are lots of different definitions of frugal innovation but the main idea is a simple, cheap, robust product. Frugal innovation is generally aimed at the bottom of the pyramid customers that have generally been ignored up-to this day despite being such a huge portion of people.

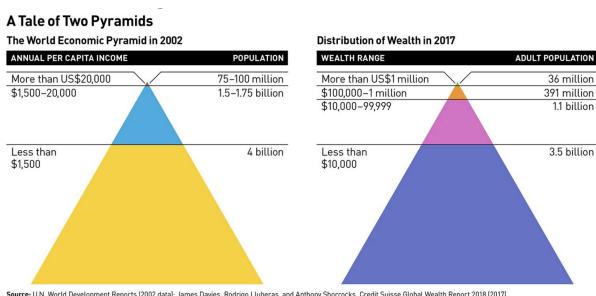


Fig. 22. Income and wealth survey statistics.

F UNCTIONAL	Low-low-end	Low-end	Mid-end	High-end
R OBUST	Robust/maintenance-friendly			Fragile/labourious to maintain
U SER-FRIENDLY	Simple			Complex
G ROWING	High volume	Medium volume	Low volume	
A FFORDABLE	Low price	Medium price	High price/premium	
L OCAL	Emerging markets	Low-end segments in established markets	High-end segments in established markets	

Fig. 23. A good example of what a Frugal product should be and is aimed at.

a) Introducing a new product into the frugal market:

- Strip down products and focus on the main function
- Build and develop the system frugally
- Build the product locally, this develops the local economy and keeps prices low
- Have a clear differentiation between frugal and non-frugal sides of the company.

b) Core competencies for frugal innovation:

- 1) Ruggedisation
- 2) Lightweight
- 3) Mobile-enabled solutions
- 4) Human centric design
- 5) Simplification
- 6) New distribution routes
- 7) Adaptation
- 8) Use of local resources
- 9) Green technologies
- 10) Affordability

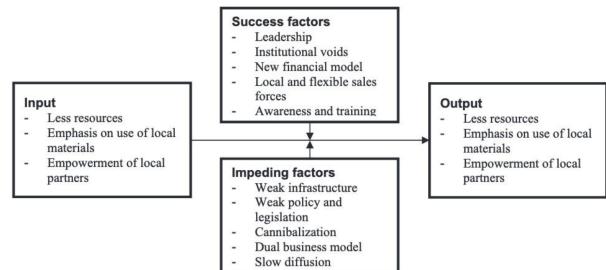


Fig. 24. Factors for a good frugal innovation product, drivers, successes and impediments.

7) Reverse Innovation: reverse innovation is when developing economies innovations are launched into the developed, richer economies. Unlike cost/disruptive/frugal innovation, reverse innovation is about the market being targeted - not a product concept. Countries such as China and India, despite developing hugely over the recent years from globalisation of western business, have been slow to innovate, different view on research and development?

8) Ethics of sustainable innovation: Who is being left out? What is being assumed? How does that impact my business? Beware fast times-to-market, non-diverse product and development teams. Step back and think!

C. Week 9: Innovation from a national perspective

1) *Systems of innovation:* Companies do not usually innovate entirely internally, they work with Suppliers, competitors and customers and other organisations such as Universities, government and researchers. Also being driven by aws, codes of practice or policies to drive or block innovation.

2) *National Systems of Innovation:* Thinking of innovation as a defined system is key when planning or understanding innovation at a national level.

a) *Thailand:* is the second largest economy in SouthEast Asia despite being the 50th largest, many have turned to Thailand to study its success in catching up with western innovation. Thailand is historically known for agriculture industry but has moved towards manufacturing, agriculture and tourism. Thailand was growing in terms of manufacturing and GDP but lacked a future plan with things such as:

- No long term stable relationships between customers and producers
- No structured cooperation between firms in the same sector
- Multinationals were not investing in developing local design and engineering
- Low research capacity in Thai Universities and collaborations that rely on informal links
- Only 20% firms using research organisations - based on technology not people movement
- < 5% even aware of the tax incentive to upskill employees
- Skill Development Department was focussed on employment, not technological jumps
- RD incentives *very* specialised and *very* difficult to access

b) *Thaksinomics:* is a name used to describe the economic method of Thaksin Shinawatra, previous Prime Minister of Thailand. This method was generally around the idea that the government needed to play a more active role in developing the markets than allowing a free-market. Thaksin listened to how companies worked together and even paired with business extraordinaire Michael Porter to plan the development. There were many plans to departmentalise the country into sectors based on outputs and cluster collaborating sectors together. Thaksin also employed tax breaks for, eg 1-2% sales on RD/design; 5% workforce being degree-educated scientists or engineers; 1% spend on training.

This innovation however was short lasting due to holes in policies and little follow through leading to resistance by the nation due to drastic changes. Issues have

c) *The United Kingdom:* has many strengths and weaknesses in its innovation, the UK is 5th Overall for innovation in Europe with strengths in science and research with 60% more PhDs than EU average and 250% international scientific publications than EU average. The UK however struggles with RD investment and increasing the quality and quantity of SMEs innovating in-house.

3) *National innovation system:* National innovation is a collection of government policies, business interaction and research organisations. The systems by how these collaborate and share information is key to success and implementation of technology. These collaboration links can be formal through things like co-publications or patents or more informal through secondments or sharing of staff. The diffusion of this technology into a company is required otherwise no innovation is ever established. The mobility of key technological players between the public and private sector is required to implement practical skills compared to easily communicated theory and research papers.

a) *Collaboration:* The linking of companies can be formal or informal and different nations tend to work in different manners. Formal alliances are very common for high cost projects such as pharmaceuticals. These collaborations are formed to share resources similar to as discussed in open innovation. Collaborations can include users, producers and competitors.

Universities, Government Research labs, research institutes all public sector research must collaborate with industry to bring these ideas into fruition. The public sector must create an environment in which this collaboration can exist and develop technology through the readiness as seen below.

Technology Readiness Levels (TRLs)

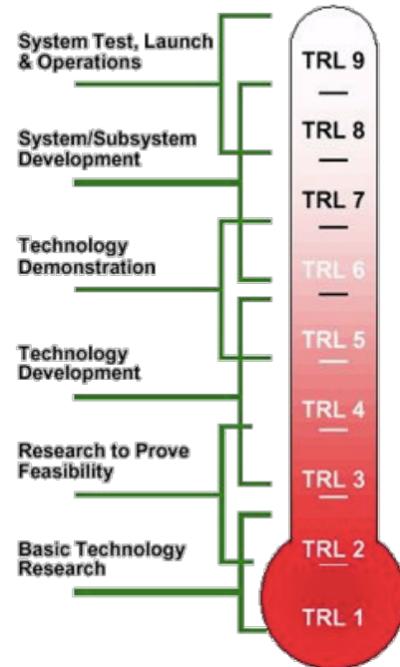


Fig. 25. Technology readiness levels, similar chasm in low values to the technology adoption life cycle

b) *Diffusion:* The performance of firms increasingly depends on putting technology to work by adopting and using innovations and products developed elsewhere. This is especially true for companies with weak R&D departments. Technology

diffusion can be a more effective way of releasing new products with reasonable margins without spending money on the expensive R&D aspect. Certain industries diffuse technology more than others such as the aerospace industry Boeing vs Airbus.

c) *Mobility*: People are important because they carry tacit knowledge - know-how, a way of doing things not easily written down. Qualifications are important, but the general approach to innovation, and an ability to solve problems, can be more powerful than specific knowledge. People moving around is good for the innovation system, and new graduates entering industry is one of the key components of this mobility.

D. Week 10: Innovation in developing economies

For almost 2,000 years, until the 16th century, China's scientific and technological developments led the world. This was then dominated in the European Renaissance starting in Italy spreading through Europe sparking advances in many areas. During the 1800s, the UK was the economic and technological leader, with an income per head that was 50% above other leading capitalist countries. By the end of the 19th century the US and Germany advanced similarly by advancing in manufacture and research respectively. Japan's Lean manufacturing processes quickly aided Japan's innovation and GDP.

1) *Catch-up theory*: Catch-up theory is a term used to describe how further behind leading nations can improve faster than leading countries by implementing successful techniques from these developed nations.

a) *The Asian catch-up: Japan*: The end of the second world war Japan's bureaucracy opened and new waves of businesses opened with governments and banks growing. With a clean slate the Japanese government pushed for development of new technology and disbandment of old ways. South Korea, Taiwan and Singapore all followed suit developing education of scientific and engineering roles and pushing for electronics companies and development.

b) *Limitations*: Catch-up requires a good national standpoint for companies to find and implement technology. Some financial structure needs to exist to allow companies to test and implement these new expensive technologies. Catching up requires an open economy to make use of international technological advancements.

c) *BRICS*: Brazil, Russia, India, China and South Africa are expected to challenge economic leadership of the US and EU. The technical catch up posed by these countries means many suspect China and India will be top of the economy in the next 20 years. In China and India almost all research comes from the top five research areas (geographically) compared to European innovation which occurs nationally spread out.

d) *Innovation Changes*: such as Globalisation of production and of R&D, especially with India and China increasingly based on their own innovative capacity rather than on mass production and cheap labour. There is an assumption that

China and India will follow suit with the EU and USA but this acceleration of industry has never been seen before.

2) *Industry geographical concentration*:

- Linear innovation - These regions have more research expenditure, educated people leading to more innovation.
- Globalised markets meaning high distribution intrinsically.
- English language remnants in India allowed for easier globalisation.
- Clustering innovative buildings together promotes a diffusion of ideas and technology.
-

Developed economies have a much larger formal market of innovation where the government provides infrastructure for innovations compared to much more informal markets in China and India. MNCs are attracted to innovation hubs for the innovation and ease of access and in turn provide money for national innovation adding to the clustering.

IV. ANALYSING INNOVATION

A. Week 11: Research methods in innovation

1) *International level*:

a) *Comparative research*: looks at differences between countries, regions or times to compare quantitative or qualitative information to classify the changes and reasons behind them. This relies upon identical data to be present between countries, regions or times to equally compare the data. Comparative data can easily overlook the events occurring such as recession from a war or pandemic.

2) *National level*: National level analysis looks at specific input and output figures such as funding for research vs GDP output.

3) *Firm level*: Firm level research is mainly based around market research to figure out what the customer likes, dislikes and what that means for your innovation. The capture of these user and customer perspectives can be used to directly influence company innovation. As customers don't always know what they want improving enhanced market research techniques may be needed to achieve base problem understanding.

4) *Traditional Market Research*:

a) *Surveys*:

- A digital or face-to-face process where respondents answer predetermined questions
- Respondents may know a lot - or nothing - about your product, service or solution
- Answers are analysed statistically
- Statistically significant, representative sample of the market
- In a business environment, the 'buyer' is often a decision-making unit (DMU)
- Survey design is harder than it may seem

b) Focus groups:

- Smaller group of users or customers who have enough knowledge about an experience to discuss a specific topic that is related to products or services

- The advantage is that participants talk to each other and have a more natural conversation, which the researcher can listen to

c) Limitations:

- Customers don't know what they want due to imagination blocked by experiences
- Aims towards incremental innovation
- Breakthrough and radical innovations rely on uncovering hidden needs
-

5) Advanced Market Research:

a) Repertory Grid Technique: (RGT) allows users to say what their needs are by asking them to talk about their preferences. The user would be asked to name 6 comparable products or services that they are familiar with. Using a structured questioning technique, the user is asked how these products (or services) differ from one another, and how they are similar. The process of describing their answer indirectly leads to their needs being uncovered.

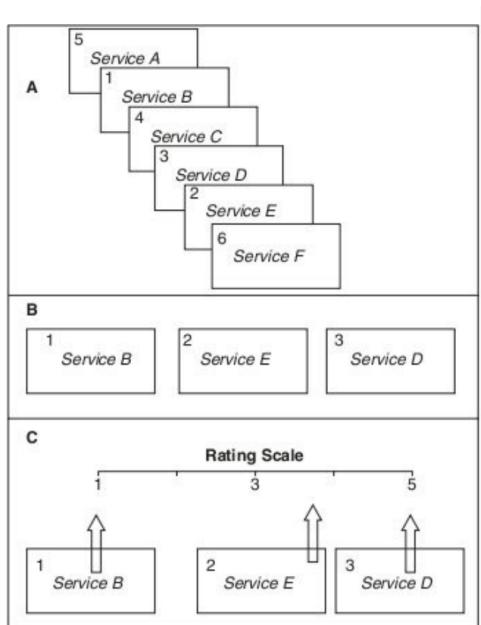


Fig. 26. RGT selection

b) Observation: Observation can be covert, but only if really necessary, and in public. Unethical? Users are observed actually using a product or service, to understand their behaviours and needs....verbal and behavioural clues. Example of hidden camera in a car to hear reactions. The observation can take place wherever the user would normally use the product, or in a neutral place. Video helps analysis

c) Lead User Method: talks to customers or users who face more challenging requirements than most of the market-place. 3M talked to a combat medic, Hollywood makeup artist

and vet. These needs are ahead of the market but may soon become requirements given improved accessibility. Lead users are grouped in threes to talk about the issues faced called the lead user group.