

Technology & knowledge transfer, types and modes of innovation and RD generations

Introduction

Transfer is transfer of expertise from an individual or organization that possesses and owns it to one that requires it

Technology Transfer involves products, processes, equipment's and software

Knowledge Transfer is transfer of tacit or proprietary explicit knowledge from an entity that possesses it to one that requires it

Transfer allows recipient to be able to create technology or use transferred knowledge efficiently within a short time. Others reinventing what others have done is risky, slow and expensive

Transfer agents

Recipient organization receiving technology. Take technology and improve their management and production activities.

Transfer organization transferring the technology . It focuses on developing technologies

Facilitator organization that aid and drives the technology transfer. Many technologies created in Kenya not transferred to organization that may use them. Indicates lack of facilitator capabilities.

- An organization can play more than one role as well as several organization can play the same role.

Transfer agents

Need to identify barriers and ways of overcoming them as well ways of catalyzing what has worked

Creating databases of:

1. Organization that have technology that they are willing to transfer. Technology information systems with information about technologies not available in Africa.
2. Organization that want technologies to adopt
3. The facilitation process for two organization to be able to transfer

Roles in technology Transfer – three processes

Technology development processes applied and basic research, prototyping and incubation.

Technology transfer support process - search for available technology, search for technology application, market needs identification, contract negotiation

Technology innovation process new technology awareness, selection of new technologies , commercialization of new technologies.

Capabilities - Sonmez

- Technological capability of a firm can be considered as a continuous process to acquire, absorb, internalize knowledge, and adapt it to local conditions, and improve it.
- It is also determined by accumulation of skills and knowledge, and by efforts to improve this
- **Channels of technology transfer.**

1. Contractual agreement
2. Joint venture

This can be between firms in same country or in different countries

Characteristics of transfer

- Process of transferring technology and knowledge should be effective and efficient
- Its should be cheaper than alternative of recipient firm learning by doing or RD to create or acquire knowledge & RD on its own and create the technology. What one technology leader organization has done most other organization dealing with same technologies can but often not as effectively or efficiently. Nyayo pioneer car could have been cheaper and done better if it had used technology transfer. Some African universities trying to develop they own editions have failed largely due to lack of technology transfer and understanding capability building. If you want to start startup based on open sources software you need to understand capability building.
- Technology transfer can occur between technology developer/user organization or between university and industry firms -

Characteristics of transfer

- For technology transfer to succeed technology capabilities of recipient as well of infrastructure of local context should be sufficient (Aszog)
- University students projects can be transferred to industry or made open source projects for further development as a way of simulating small scale IT businesses. Patenting some components of student projects can enable students make some money and start carrier in innovation. but projects should be innovative.

University –industry transfer

- University –industry transfer common in developed countries but not common in Kenya
- Percentage of commercialized research in developing countries very low. Doing research that won't be commercialized according to Lean is a waste. However no country commercializes all its research
- Lack of technology information system that has information of what technologies are available, what is needed and projected future technologies both short and long term.
 - Just like farm product sales people need to know what farm products are available and farmers who want to sell – intermediaries a technology system enable farmers and sales people communicate

Reasons for University tech transfer

1. Giving back to society
2. Seeing ideas created by university being put into practice and changing lives
3. Enriching research opportunities for students
4. Improving reputation and ranking of university
5. Making the graduates more attractive to Employers compared with competing universities

Types of transfer

1. IP transferred through licenses which owner grants technology rights to a third party. The owner decides rights to give and ones to deny
2. Process of patenting your invention and getting right person to license to maNy take years

Toronto univ Tech transfer process

1. Research – observation and experiments often lead to discoveries software, IT and other copyrighted work
2. Invention disclosure –inventor discloses his/her invention
3. Assessment – for patenting , marketability and commercialization
4. IP protection – filling a patent may take years and millions of dollars in developed countries
5. Marketing – identify candidate companies with resources, business networks capable of bring innovation to market. This may involve partnering with a company or creating a startup
6. Selecting a license
7. Licensing – licensee continuous advances technology and makes other business investment to develop product or service
8. Revenue and reinvest – revenue generated distributed to departments, inventors and units

Possibilities

1. Working in university or research institution – you will follow institutions process of research, invention and patenting
2. You can approach a university or research institute to a license to you an invention that you can commercialize
 - Its usually not easy to have all the skills and resources to invent and commercialize. The risks also increase if you carry out a RD project through out all the phases.
 - Some risks can be reduced by partnering although this introduces other risks

University technology transfer and commercialization strategy

1. Encourage commercialization of research results. Some good student projects should be supported for commercialization.
2. Create partnerships with organizations with complementary abilities.
3. Creating a technology transfer culture
4. Creating spaces for innovators to interact
5. Encouraging staff and students to innovate and rewarding their efforts

Two ways of univ and industry transfer AZOG

- Both university and firm participate in RD
- University carries research alone then university transfers the technology
- Developing countries lack information on available technology, successful technology development processes and sometimes research done is not based on market needs

Ways of innovation are created RUIZ

- Researchers can create technology then find firms to transfer to
- Organizations can approach innovation market places such Innocentive and Ninesigma
- Definition Innovation market place – intermediary organization or brokers that go between organization and innovators and ensure that process is successful

Researchers RD and technology transfer process Gorschek et al.

1. Identify problem – based research on industry needs
2. Problem formulation – study state of art – base you research on several companies
3. Formulate candidate solutions in collaboration with industry
4. Validation – validate solution by interviews, pilot prototypes and controlled small tests
5. Release solution – stepwise release to industry still being open to small changes

Two modes of innovation

- Science research and development –(STI)
- Doing using and interacting - (DUI)

STI uses codified scientific knowledge

DUI uses informal learning and experience.

Much of the practices in most fields are partially understood. This type of learning may occurs as unintended consequence of designing or developing products. Innovative systems based on learning from doing largely use tacit knowledge

DUI

- Areas that don't have sufficient knowledge should use DUI
- Most New artificial intelligence applications and some radical innovation software engineering application use proof by demonstration – where its not know whether creating application is technologically possible and so developing the system is proof-by demonstration

Students application of Two modes of innovation

- Should learn from doing interacting, using and developing IT technology.
 - Some of lesson learned can be used to innovate. Being an IT profession is not just about leading published literature and basic research but also learning from doing and using. When you write programs, manage systems and carry out other IT activities you should learn from doing
- Most of knowledge and practices used in software engineering originated from DUI.
- Turn basic research into applied research and use it to develop IT technologies in STI mode
- Consider do adjust entrepreneurship depends more on DUI than STI

Two modes of innovation

- Mode 1 – innovation done within the firm based on knowledge within the discipline
- Mode 2 - innovation done using multidisciplinary or interdisciplinary knowledge and across boundaries of firm. This currently the mode that being widely used. In beginning of startups if you are only employee you innovation in several disciplines of knowledge your manager, salesman, technology developer, public relations, account. In areas your are not trained you innovate by improvisation and DUI

RD generations - Nobelius

- 1st generation – technology push oriented and aimed at technology breakthroughs(technologies new to the world – radical technology innovation).
- 2nd generation - market pull oriented and based on project management
- 3rd generation - based on having groups of RD projects being undertaken by company at same time

RD generations – Nobelius ...

- 4th generation – learning from and having a customer focus and activities carried out by cross functional teams
- 5th generation - RD network - involving cooperation with wider system including suppliers, customers, competitors and distributors

RD generations – Nobelius ...

- 6th generation – A Consortium of companies formed to carry out research in which participating members can commercialize either as individuals or form teams made of member firms of consortium.
- Participating members of Consortium expected to allow use of all their essential patents by Consortium

Types of innovation

- Incremental innovations – small changes to knowledge of components and relationship between components
- Modular innovation – using new knowledge in components
- Architectural innovations – change the relationship between components
- Radical innovation using new knowledge in components and creating new relationships

Types of innovation and technology transfer

- Important to understand the type of innovation that being adopted.
- Radical innovation most complex to transfer and adopt, have highest risks are more likely to have drastic improvements by adopting organization
- Incremental innovation easiest to transfer and adopt
- Modular innovation – require learning new knowledge of components as its different from knowledge of previous technologies. Organization adopting Nano computers has to learn knowledge about Nano technology

Importance of Understanding Types of innovation

Important for firm or startups to understand types of innovation because they differ in:

1. The process of innovation
 2. Economic impact of innovation
 3. The role of manager
- Radical innovation is long term, has large economic impact, manager has to sort good approaches from bad ones
 - Incremental innovation is short term , requires less resources and has immediate impact

Importance of Understanding Types of innovation

- Incremental innovation is short term , requires less resources and has immediate impact
- Incremental innovation contributes to 80% of productivity gains of firm
- Radical innovation contribute to wealth of nations
- Many developed that are world technology leaders has be through radical innovations

Application of knowledge in tech dev

Technology innovation involves exploration of application of knowledge to practical ends

1. Applied research usually consist of scientific investigation that doesn't advance scientific knowledge
2. Development reduces knowledge to practices in a workable prototype

Application of knowledge in tech dev

3. Engineering – converts knowledge into a form suitable for commercial exploration or other practical ends. The prototype is converted into form that can be used in market

4. Commercialization includes activities like manufacturing that finally produces technology that can be sold. Software doesn't include manufacturing – hardware manufacturing is equivalent to copying software on DVD or making available for download on web. It almost costs nothing

FIRM LEVEL technology development

1. Problem recognition – recognizing potential for technology in product and services
2. Technology selection firm formulates several design concepts usually based on different technologies
3. Solution development firm selects design concept to be developed further and refines the design concept and converts it to a prototype
4. Commercialization – product released into market and profits obtained

Software technologies

They take 25-20 years from basic research concept development to wide usage in industry

Object oriented technology is an example

- Programming language object concept first introduced in Simula programming language
- C++ object programming language then created
- First Object oriented analysis and design methods to UML

The time take from concept to wide usage in industry has been decreasing with time

Technology intelligence

1. Those investigating technologies must know what others are doing and how they might affect them
2. What technologies are likely to emerge in future how might affect your business
3. What advances are likely in core technologies? What core technologies are maturing and what might replace/substitute them

Technology intelligence

1. What capabilities do our competitors have and how might they use them against us?
2. Are we about to be blinded folded by our past successes?
3. Who is working on technologies that might benefit us and how can we access – e.g. by technology transfer