

TRANSFER OF TECHNOLOGY – TRANSFER OF KNOWLEDGE

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1. TECHNOLOGY TRANSFER

In general we mean by technology the pieces of knowledge necessary to produce a thing (object, idea, procedure) including the product to be produced and/or the service, the process of implementation (production-distribution) and all the knowledge related to all these (management-organisation, experience, proficiency).

By transfer of technology we understand the flow of all these technology and knowledge pieces between different organisations and individuals both in the home country and foreign countries as well.

Nowadays technology in a broader sense is defined as a special kind of 'know-how' or the sum of knowledge and experience.⁴ It is of primary importance that this approach does not narrow the concept to special procedures of production or to the knowledge of production technology but regards it as something complex, that is the scope of knowledge needed to set up the enterprise, to organise the system of production – distribution and to operate it.

If the word 'technology' is used as an attributive referring to a transfer process we can accept the interpretation that it is actually the sum of technical skills and immaterial knowledge that enable people and organisations:

- to perceive new problems
- to develop new concepts
- to elaborate work out new solutions
- to implement new labour division between people and organisations,

which will result in a new product or service. Transfer is imparting and communicating knowledge to those who do not possess it (national economy companies, institutions, individuals).

1.1. Transfer of technology as a tool for creating knowledge

When technical knowledge is created, the transfer of knowledge can be implemented on different levels. It can range from the simplified physical literal process of taking possession of machines, equipment and instruments to learning the necessary technology for one or even several years to operate it most effectively together with adaptive changes made to the original system. The events and final outcome of this process also depend on to what extent the

innovation is competence-destroying or competence-enhancing. In such a complex transfer programme you need both individual and organisational learning. Individual learning begins with gathering experience related to technology, the perception of which results in the implementation of personal knowledge modifying individual skills and knowledge. Organisational knowledge comes about by totalling individual knowledge. At this point, however, synergic effects can occur but on the other hand the organisation is able to learn only to an extent that individuals are capable of changing the results of personal learning into organisational routine (culture building element).

Exchange of knowledge in the transfer – adoption process of complex systems take place on two levels:

- *First level:* Package of knowledge summarized up by the creators of technology for the operation of the imaginary function. This facilitates the increase of knowledge in a direct way.
- *Second level:* Package of knowledge created by users of technology while using and adopting it. It can feature fairly creative and innovative elements (reinvention). The knowledge created by the user also has a certain reaction and the information instrumental for the innovator can provide a starting stimulus or actual solutions for planning the next generation.

The empirical examinations³ in this field prove that classic transfer processes rather hinder than assist bilateral exchange of knowledge. 'Schumpeter Theses' also reflected this contradiction when he concluded that the innovator aims at temporary monopoly. The faster the innovation spreads, the sooner the opportunity to gain advantages and extraordinary result comes to an end. To characterize the present situation Kamien aptly stated,³ that the behaviour of the participants at competitive markets means much more accumulating and hiding know-how than transferring them.

Limitations and characteristic of transfer of knowledge

1. Technical knowledge is highly specialised and immobile as it also includes users' experience. This experience itself contains innovative elements since using technology means integrating new inventions.
2. The main task of the potential donor and receivers of highly-developed technology is to demolish the barriers of knowledge.² It should not be an isolated activity. It requires a special network of cooperating contributors.
3. There are institutions intermediating between the donor and adopter.

The tasks of these institutions are various:

- Communicating know-hows from the donor to the adopter;
- Reflow of users' knowledge from the user to the donor;
- Providing methodology to accelerate individual learning processes;
- Documentating experience gained through individual learning;
- Methodological support and acceleration of organisational learning and proposing changes in order to achieve these objectives.

4. The work of intermediating institutions is effective because they can profit from the merits of 'economy of scale'. Each receiver shares every moment of the reception and integration as an individual event. They cannot draw any general conclusions from the phenomena seeming individual to them. The intermediary, however, can acquire special knowledge and institutional base of knowledge by synthesising 'individual' phenomena and evaluating repetitive things.
5. Nowadays there are several opportunities to acquire the advantages of technology:
 - a) Utilisation of advantages (transfer-adoption) owing to possessing technology without owning the technology.
 - b) Purchase of advantages important for the adopter as a market service from an intermediating institution.

The latter model has widely spread because it can offer much more advantages than the direct transfer:

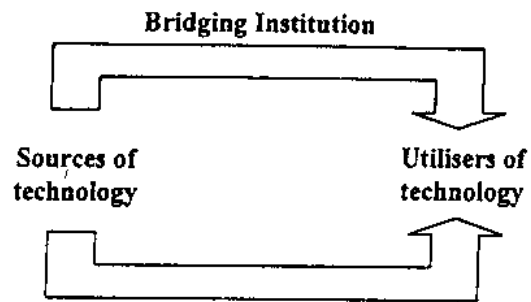
- a) You do not have to create technological knowledge within the organisation (competence-destroying).
 - b) The learning process does not have to be completed (acceleration).
 - c) The costs of technology can be allocated to several partial customers.
 - d) The intermediary can get specialised and his/her own organisational knowledge can improve.
 - e) The adopter can achieve a complex exchange of knowledge without owning the whole range of the technical knowledge from the very beginning.
6. Innovators are searching more and more consciously for the methods to reduce the knowledge-pressure on final users. We consider two of the effective;
 - a) service packages are elaborated to transfer knowledge (training programmes)
 - b) Staff is trained for self service by intermediators. Temporary integration of a decentralized training staff into the organization.

1.2. Transfer Models

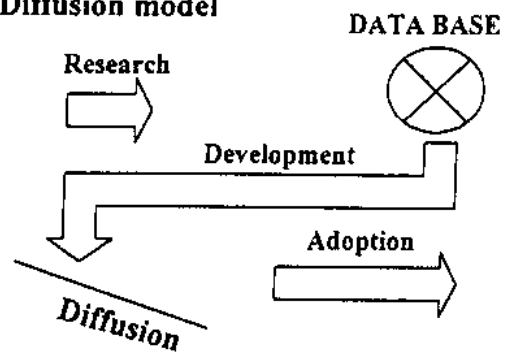
The transfer-processes presented so far have obviously provided a principled background to achieve the goal. Next we shall present some models summarising the relationship of the characters (fig. 1. And 1.)

The relationship-building Model highlights the importance and role of institutions providing flow of information. These institutions realize the relation between demand- and supply side by facilitating meeting of potential partners, who are guided by programmes tailored to their needs. The purpose of all this is to find a goal-oriented and practical mechanism.

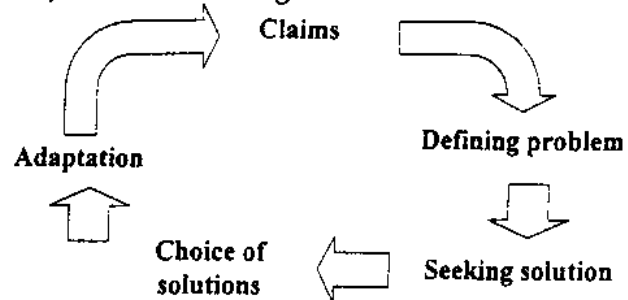
a) Relationship-building model



b) Diffusion model



c) Problem solving model



d) Action-oriented model

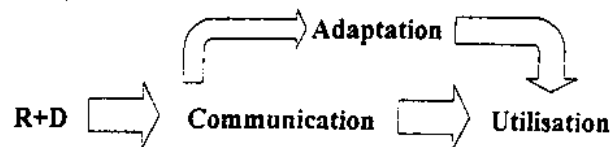


Figure 1. Methods of transfers technology

The Diffusion Model focuses on linking suitable technologies with diffusion potentials. It looks for participants for different moments of research, development and adoption, who have an interest in rational labour division. It's able to adopt more complex mechanisms as well and enables a more effective utilisation of the diffusion potentials of the receiver side, which enables the relationship-building model is mainly profitable for initial or occasional transfers since it insures the cooperation between few participants in a well-arranged system. The diffusion model is a practical model for quick mass wide spreading, which enables the availability and cooperation of many participants at a time on the receiver side.

The 'Problem-solving' model starts out from clarifying and surveying the needs. It regards the needs as technological shortages to be solved and starts a problem-solving process from them. The final solution is within the possible solutions sought by determining the directions of adoption. It is very essential about this logical system that it does not only overview and qualify the selection but is also evaluates the willingness of the donor to adopt. This concept does not simplify the transfer to a mere transposition of the possible available technologies but it aims at the best possible meeting of the basic demands.

Problem defining and seeking solutions are based on the active cooperation of the would-be adopting organization. This model as such also goes beyond simple commercial affairs.

The 'Action-oriented' model organizes and joins the process elements on the basis of economic utility. It is based upon the idea that all novelties feature a life-cycle of marketing. It takes place under competitive conditions. The innovator-distributor can turn it to advantage if he is well-prepared in the early phase of the distribution and if he can cooperate with adopters forced to be loyal by contracts. This adoption does not only involve a simple transfer or growth of mass but it also includes further development tailored to local needs. It is not accidental that this model is extensively applied by international firms, especially when the donor has to collaborate with a target market in a target country whose culture is extremely different from that of its own. (e.g. European projects of Japanese firms, huge American companies in African countries.) All firms applying global strategies came up with similar solutions in the early stages of internationalisation.

Nowadays the so-called 'Model of exchange (fig. 2) of knowledge also including feedback is becoming more and more current.

The model is closed in one direction by the donor who follows and in many cases encourages and assists the further-development efforts of the receiver. In order to compensate these efforts and expenses it supports a transfer to a third party. Besides this, it also takes over some development results and after a proper analysis it integrates them into its own new programme. Further transfer cycles will provide an opportunity to distribute these novelties on a global scale. This model can be observed very well in transfers between

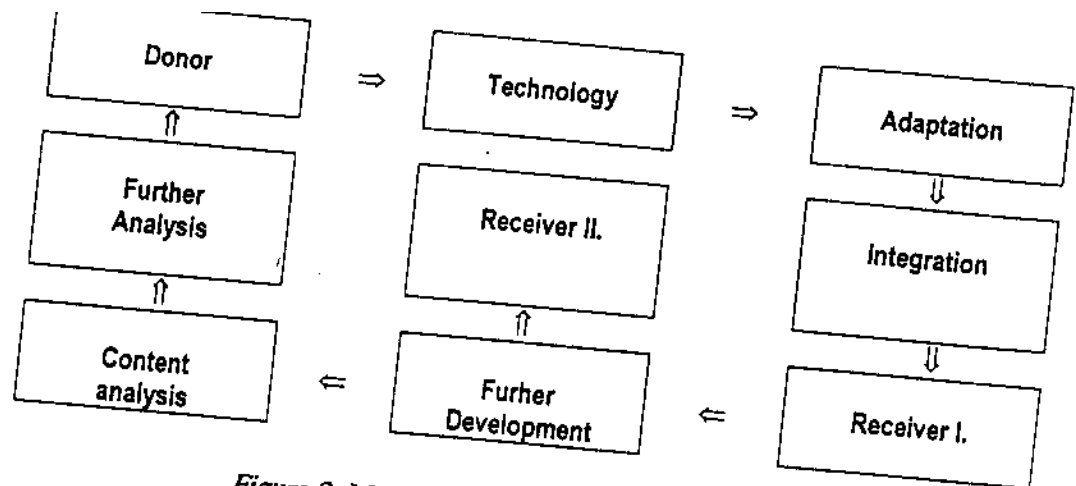


Figure 2. Model based on Transfer of Knowledge

international companies and in projects tending the transfer of means and process of production. In the first case it is the interpersonal relations within the company and K+F external branches that function as prime movers in the process. In the second field it is the customer services that carry out the necessary information gathering through their monitoring system. The model is actually an effective tool for implementing external and internal technolopartition, which is nothing else but the conscious allocation and movement of knowledge technology and resources between the suitable participants of the transfer with maintaining mutual bebenefits.

2. THE TRANSFER OF KNOWLEDGE

2.1. Personal and organizational knowledge

Experts specialized in theories of knowledge distinguish two basic types of knowledge: (table 2.)

a) Tacit knowledge:

- Personal situation, specific knowledge that awaits allocation.

b) Explicit (codified) knowledge:

- Official knowledge recognized by the organization which can be transferred and preserved in a systematic language.

Polányi¹ classifies 2 main types of knowledge. According to his we can distinguish:

- tacit and

- explicit knowledge. (see table 2.)

Table 2.

Two types of knowledge

Tacit knowledge	Explicit knowledge
Subjective Empirical Simultaneous (here and now) Based on analogues Cognition-oriented Technics content	Objective Rational Past event (then and there) Modelled Synthese-orineted Theory-based
Specific	General

Knowledge is always created by individuals, the mass knowledge is accumulated with individuals, that is why the organization cannot solve problems without individual contribution. Creation of organizational knowledge creation is a process which

- collects and reframes creative individuals
- on the one hand, on the other hand, it also integrates the pieces of knowledge into the organization and crystalises them.

It is the process and mechanism that operate in knowledge creation between the organizations.

Implicit and explicit knowledge have to be conceived as a unit mutually completing each other, that interact during creative activities and get interchanged.

There is a debate about the utility of the different types of knowledge and their related applicability. Different cultures feature different priorities. Management trends based upon oriental culture rely on implicit knowledge, whereas western culture (American, European) emphasize explicit knowledge.

We think that the right approach is not to highlight the differences at all. Human knowledge comes about as a result of interaction between implicit and explicit knowledge, consequently pieces of knowledge can only be isolated artificially in individuals. This interaction is called knowledge conversion, leading to the continuous expansion of knowledge elements of social scale, size and scope.

Knowledge conversion can be classified into four main modes: (Figure 3.)

1. SOCIALIZATION:

- It is a process of sharing tacit knowledge focusing on the transfer of technical skills through experience.
- Observation, imitation and individual practice result in sharing knowledge.

	Implicit knowledge	Explicit knowledge	
Tacit know- ledge	Socialisation	Externatization	Starting position of know- ledge conversion
Explicit know- ledge	Internationalization	Combination	
Direction of conversion			

Figure 3. Model of knowledge conversion

- Observers are supposed to adapt to the thinking process of another individual- so that the knowledge element should be recognizable.
- The main criterium of qualification is perfect correlation.

2. EXTERNALIZATION:

- It is a process of converting tacit knowledge into explicit concepts.
- It focuces on creating models.
- It is essential that it should aim at documentation.
- It is driven to create concepts.
- Inventing analogy facilitates to understand the unknown through the known. Thus bridging the gap between an image and a logical model.
- The association and synthetization capability of the reception side determines the quality of conversion.

3. COMBINATION:

- Combination is integraton and systeming explicit knowledge.
- Gathering, sorting, replacing, combining and categorizing existing information can lead to new knowledge.

4. INTERNALIZATION:

- It is embodying explicit knowledge into tacit knowledge.
- It involves the phases of creating know-hows.
- Explicit knowledge has to be recorded (books, journals, ets.) to make the process of creating new tacit knowledge available for everybody.

Knowledge-spiral:

Knowledge-spiral is a process where socialized knowledge becomes internalized knowledge by going through externalization and combination.

The maintenance of knowledge-spiral and creation of ideal modes of knowledge can be promoted by socialization that expands the field of interaction (many observes), by externalization seeking adequate analogy, by combination creating networks of knowledge together with internalization providing the conditions of act – orientes learning. (Figure 4.)

SOCIALIZATION SYMPATHIZED KNOWLEDGE	EXTERNALIZATION CONCEPTUAL KNOWLEDGE
INTERNATIONALIZATION OPERATIONAL KNOWLEDGE	COMBINATION SYSTEMIC KNOWLDEGE

Figure 4. Including of knowledge-spiral

2.2. Learning Organization

Organizational learning is associated with organizational changes and changes in efficiency related to them. Organizations are characterized by their activities. These involve individual activities (violinist playing the violin, drummer playing the drums) together with collective activities. Individual activities can come about by themselves, while collective activities can only come about through activities of coordinated individuals.

Human knowledge accumulated at individual levels always manifests itself as the capacity of a group, which is actually the collective knowledge of the group-by manufacturing products of providing services organizations demonstrate what they can achieve. Thus, organizational knowledge embodies a category of activities that can only be carried out by the group but not by the individual. Organizational learning is practically a process in the frame work of which the individuals and the group acquire the know-how needed to implement collective activities.

To avoid possible misunderstandings, we must add that individual learning is obviously of larger scale than collective development of abilities and represents a different kind of quality since the individual durably possesses the accumulating knowledge, whereas the group does not.

Organizational knowledge is specific of each organization. This entails the fact also supported by experience that organizations doing identical activities realize their tasks in different ways. What is more they focus on distinguishing features when creating their own know-hows.

Organizational knowledge aims at:

- The increase of personal tacit knowledge which broadens the knowledge base of the group.
- In its knowledge base the organization has to aim at the concentration of knowledge created at the individual level but it has to accumulate knowledge supported by the organization.

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- The stronger the interaction between explicit and tacit knowledge, to the greater extent knowledge-spiral creates the different generations of innovations.

2.3. Basic models of renewing knowledge

Organizations occasionally need renewing knowledge. Thoe process is rather hazardous and it is difficult to recognize the optimal time for renewal. A knowledge-creating company ready for renewal is always characterized by being able to create systematically the process of knowledge renewal. As for concrete systems, three basic models can be distinguished. (Nonaka, 1995).⁴

Basic types: (Figure 3.)

- It is based in the mechanism moving from the top of downwords: “Top-down” system;
- The system building upwards from “Bottom-up” system;
- Integrating type: “Middle-up-down” system.

Top-down system:

It is based on classic hierarchical, centralized management. It can be classified into the socalled knowledge-creating models. It puts the top-management with the network of experts in the very centre who recreate the conceptual set of the company according to general development trend and integrate it through intensive communication into the information system of the executive level (plans, instructions work methods etc.). It is built upon the conception that the top-management is capable of complete and continuous creation of knowledge and processing information. This model is suited for processing explicit knowledge, but it does not bring about tested knowledge, as there is no direct upward communication. The accumulating knowledge does not move to a higher level and is not synthetized.

Bottom-up system:

It is the mirror image of the ‘top-down system’. It is based upon the autonomy and creative abilities of the employee. In this system communication relies on the free choice between vertical or horizontal direction. It is frequent interaction between individuals that creates knowledge. Tacit knowledge gets integrated into the operative work of the company. Due to causal interactions, complexity and continty are hard to provide.

Middle-up-down system:

Middle managers are the key to creating knowledge and are the operators of knowledge-spiral. (upwards-downwards). It is them who get both ideas imported from outside the firm and -their inner experience. In one direction (from top to bottom) they act as "interpreters", whereas in the other direction (from bottom to top) "they function as information processors".

3. DIFFUSION AND TRANSFER OF KNOWLEDGE

The concept of diffusion is suitable for naming an essential moment of innovation process, that is adoption and spreading on the one hand, while on the other hand it is also apt for describing a dynamic motion which includes the different motions of innovation in space and time.

The effect of diffusion is never limited to the wide application of an innovation, but the members of sending and reception also become participants of knowledge-transfer, knowledge-expanding and knowledge-growing process. It is not accidental that each main factor determining the speed of diffusion is directly or indirectly linked with forces knowledge-transfer.⁵

Main factors:

1. Relative advantages:
 - advantages of use and value in the novelty.
2. Compatibility:
 - forces changes on the user's side (way of life, production organization);
 - size of discontinuity;
 - costs or loss of change (training, change in the set of values).
3. Complexity:
 - complexity of directions of change;
 - interconversion of changes.
4. Cognizability:
 - opportunity to get information before final adoption.
5. Presentability:
 - Prior lucidity of the process of getting information and that of the application process.

In diffusion knowledge equalization between the donor and adopter can be accelerated by intensive communication. Within this communication we distinguish two levels:

- knowledge of signaling
- knowledge of know-how.

Signaling serves for informing about the emergence of novelties and their potential availability together with presenting their assumed advantages.

Signaling information is compact news repeated in different forms and spread through concentrated channels. The primary function of repetition is much more to confirm what has been said than to cease the uncertainty of receivers or eliminate the information gap, but to enable the introduction of the offering side. The most crucial factors of spreading and integrating this information are:

- time of communication
- scope of intermediating network
- feed back of prior, successful adopters (receivers).

Knowledge of know-how level features the details of realization and feasibility together with a detailed specialized knowledge linked with it.

Acquisition of technical knowledge is more difficult and takes longer than to recognize the existence of a novelty. Despite this there are many, especially in the first phase of the novelty who want to act experts of signalins level.

To acquire knowledge of know-how level we need detailed information highly differentiated both in quality and quantity. The function of this information is not only to inform decision makers and influence them but also to reveal the details of implementation.

Signaling information including knowledge derivated from it spreads fast and widely consequently their absence does not mean a problem any more, excepted when the signaler focuses on an intentionally exclusive range of receiver models.

(Table 4) describing the nature of diffusion processes can be divided into two main types:

- a) Models from technological perspective:
 - The phenomenon is described from the perspective of technical-economic benefits gained by the change.
 - The dynamism of spreading is evaluated from the perspective of costs and profits.
- b) Knowledge-based approach:
 - The process is described as a complex chain of communication and interaction.
 - Knowledge equalization is in the focus as members' main activity.
 - Dynamism of the process is attributed to the effectiveness of communication.

Common weaknesses of models and basic theories:

- members of the process are considered rational decision makers, however, it cannot be insured in the multi-step praparation systems of the demand-and supply-side on base of knowledge;

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- adaption possibilities are different for potential adopters, the members of the demand-side are not equal;
 - market and non market factors of the institutional system communicating new technology are of different efficiency;
 - the active, goal-oriented institutions of the supply-side highly influence and provide packages of knowledge to be transferred.

The efficiency of diffusion is affected by several factors from the perspective of transfer of knowledge as well.

These are basically connected with the different levels of integration in learning and gaining knowledge:

1. Limitations of organizational learning:
 - the organizations of the donor-and receiver sides do not get integrated,
 - the opportunity of direct change of experience is limited,
 - missing knowledge is created by the adopter side (trial-luck).
2. Complexity of know-hows:
 - know-how is created in the knowledge base of the supply-side, thus it is not completely suitable for integration into the adopter-side,
 - we have to wait till the usage experience of the adopter-side is mature to insure readiness for adoption.
3. Preparedness of transfer institutions:
 - the existence or absence of knowledge beyond signaling knowledge,
 - existence of conditions for tailoring the institution to needs.
4. Information level of communicators:
 - efficiency of prior preparation.
5. Economy of scale in preparation:
 - Availability of adaption experience obtained by communicators.
6. Maturity of technology:
 - knowledge relying on experience gained in an early life-cycle of transfer is uncertain,
 - Only few experts available who have to be paid highly.
7. Obtaining knowledge by service companies:
 - sub-tasks of the adopter side are implemented by specialized service companies.

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