

# Models of Knowledge Transfer for Sustainable Development

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**Abstract.** Sustainable development requires that distant organisations connect to one another and exchange knowledge. Online social networks have the potential to support these processes. It is however important to understand and model the processes of knowledge transfer that can effectively occur on the Internet. This paper explores recent literature with the purpose to highlight relevant formal approaches that can help to model and analyse the processes of inter-organisational knowledge transfer for sustainable development.

## 1 Introduction

Sustainable development requires that distant organisations, specialising in complementary areas, connect to one another. Knowledge transfer mechanisms can, in principle, help sustainable development [15]. In addition, online social networks, by design, have the potential to be adopted by the developing parts of the world given the accessibility through the mobile platform.

It is therefore important to understand and model the processes of knowledge transfer that can occur on the Internet [16]. This paper explores recent literature with the purpose to highlight relevant notions and formal models that can help to understand and analyse the processes of inter-organisational knowledge transfer for sustainable development. The purpose is to underline some basic points that can be helpful for supporting business management and policy making for favouring sustainable development. Particularly attention is paid to aspects of (a) social networking, (b) knowledge flows, and (c) knowledge protection and disclosure, as relevant to our position.

## 2 Social Networking

Modern communication has been transformed by the advent of the Internet. The extent of this transformation allows for truly global and open innovation to be a reality. The Internet has allow for media of all types (including video, audio and text) to be

- globally accessible, communicated and created anywhere in the world,
- exchanged in higher volume, allowing high-scale storage and transfer,
- communicated at higher speeds, providing very fast speeds links to all kinds of devices,
- open for interaction and integration, to allow for various kinds of devices to share the same platform ranging from PCs to tablets to phone and other consumer devices,
- collaborative, allowing multi-user environments through chat and voice communication tools, and
- pervasive, such that this media is present anywhere and everywhere thanks to mobility and the concept of Internet of Things (IoT) that brings on all kind of unconventional devices connected to the Internet.

One of the notable trends over the last decade has been the emergence of Web 2.0. Ian Davis [7] describes the notion as such

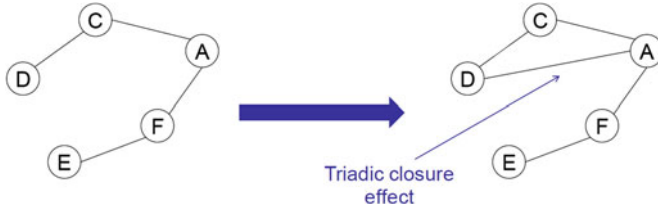
“Web 2.0 is an attitude not a technology. It’s about enabling and encouraging participation through open applications and services. By open I mean technically open with appropriate APIs but also, more importantly, socially open, with rights granted to use the content in new and exciting contexts.”

Undoubtedly, Web 2.0 helps to readjust the focus of the Internet from *information* to *people*, who are the producers and consumers of information, and more importantly, have the ability to innovate. This is achieved by

- the growth of Web authoring styles that enables people to collectively create and maintain shared content,
- people’s personal data moving online from their computers to the services and cloud, and
- a growing trend of linking styles that provides for online connections between people (and not just between web pages and documents).

Online social networks, such as Facebook and Twitter, are successful manifestations of Web 2.0. Such networks provide for a great opportunity for developing and emerging countries to participate in the global process of knowledge transfer and innovation. This appears particularly promising as the Internet becomes reachable over mobile platforms, which have achieved remarkable penetration in some of the developing regions of the world. Mobile data traffic is expected to grow to 10.8 exabytes per month by 2016, an 18-fold increase over 2011 [6], and estimates suggest that by 2015, mobile access will become more widely available than electricity in the regions of Middle East, Sub-Saharan Africa, and South- and Southeast Asia [6].

Social network theory provides an insight into how communities emerge. The principle of *triadic closure* suggests that if two people in a social network have a friend in common, then there is an increased likelihood that they will become friends themselves at some point in the future [10]. This principle is illustrated



**Fig. 1.** The principle of triadic closure in social network theory

in the simple diagram in Fig. 1, where the theory suggests that *A* and *D* have an *opportunity* to form a link due to a common link with *C* and a basis for *trusting each other* due to this common link, along with *C* also having an *incentive* to bring *A* and *D* closer.

This provides an insight into how communities with similar interests emerge and become a critical mass to sustain knowledge and promote cross-beneficial innovation [9]. Such communities have the potential to connect people into far reaching places of the globe, as per the *small world* phenomenon [10] that suggests that any two nodes in a social network are separated by no more than a few degrees of separation.

### 3 Knowledge Transfer and Its Relevance for Economic Development

To connect into social networks by means of new Web 2.0 applications is important for local economies, provided that the relevant interacting players are willing to share their knowledge. The possibility for companies to get access to the results of knowledge production performed by others, and especially by “big” labs and high tech companies [1,4,8,11] is a fundamental ingredient of economic development. The purpose of this section is to highlight formal models that can help to understand knowledge transfer mechanisms and their economic implications.

A first important issue is that organisations can engage in different kinds of interactions involving knowledge flows [2,3]. In a strict sense, knowledge transfer can be seen as the situation where a subject possesses a piece of knowledge and gives it to another subject (a payback is not explicitly considered here). An important aspect of knowledge transfer is that this process is really effective under specific conditions: the receiver has to assimilate the piece of knowledge, which implies an active process of learning. While knowledge transfer is generally a bilateral model, knowledge sharing is, instead, a situation where a piece of knowledge is shared between two or more subjects: the assumption is that all the subjects share not only the knowledge but also the appropriate mechanisms to understand and use it. Also, all the parties can act as sources and receivers. Knowledge exchange is a mechanism where a source gives a piece of knowledge to a receiver, provided that the latter pays it back. This situation is particularly

significant in economic terms, because it implies the existence of a “market” for knowledge. The last case is that of knowledge transaction, that is different from knowledge exchange because, in this case, the payment is represented by another piece of knowledge that flows back: in other words, the source is willing to give a piece of knowledge to a receiver provided that the latter teaches something useful to the former.

This formal distinction is useful for the topic treated in this paper, because it helps to underline some basic questions that need resolving. For example: how do interacting organisations communicate knowledge effectively? When can this be useful for economic development? How do companies in developed countries can pass useful knowledge on to developing countries? What infrastructures and mechanisms are more appropriate for this? For example a case of knowledge transfer is that of a research institution that publishes the results of some scientific activity: in this case, the transfer is really effective only when the receiver (for instance, a company in a developing country) is able to assimilate that knowledge content properly. This means that simply diffusing technical or business information can be not enough, unless the receiver is properly trained to assimilate that content. An example of knowledge exchange is, instead, that of a company selling a patent to another company: in this case, it is the financial capability that allows the second company to really gain the economic benefits of the technical/scientific invention. Again, this raises special questions: can companies in a developing country have the financial resources to buy knowledge from abroad? What policies can help this process? Another emerging approach used to formally analyse the effectiveness of knowledge flows is that of agent-based simulation. For example, Strohmaier *et al.* [14] use an agent-based simulation model to investigate the effectiveness of knowledge transfer mechanisms that can be adopted in the light of potentially conflicting stakeholders goals. As a matter of fact, while research on the effectiveness of knowledge transfer is often based on empirical observations (i.e. case-studies or surveys), the authors claim that a knowledge-based simulation can help to explore the conditions under which a particular mechanism of knowledge transfer can be effective.

A second issue that is relevant to our analysis is that of the strategies of knowledge protection/disclosure. This is clearly associated to the issue of knowledge flows. Knowledge protection is generally intended as a way to protect the capability of a company to produce or commercialise innovations: by protecting knowledge, a company avoids that precious knowledge is unintentionally transferred to others for free. It is clearly not possible to protect all the knowledge that a company produces [13], but there are popular mechanisms like patents, confidentiality agreements, secrecy, etc. that are often used by innovative companies, sometimes very effectively. Patents are the norm in some industries, for instance Pharmaceuticals or Biotechnologies, and it is often matter of debate if this protection mechanism is fair (think, for instance, to the case of orphan diseases) or beneficial to economic development.

Conversely, the recent literature highlights that there are situations in which a strategy of knowledge disclosure can be beneficial not only to the potential

receiver but also to the source: in the open innovation model [5] it is assumed that the complexity and high risks of innovative activities call for an open co-operation where companies with complementary competencies can fruitfully share and integrate their knowledge, and can benefit of mutual learning.

Given the critical question about whether protection or disclosure is more beneficial, several studies have attempted to formally model the mechanisms of knowledge protection or disclosure and their potential effect on knowledge transfer efficiency. A common formal approach is that of game theory, which is used to investigate the situation of equilibrium between protecting and disclosing knowledge in terms of the relative distributions of advantages and disadvantages. An example of study is that by Ponce [12], who analyses a case of two companies, one of which can imitate the innovation discovered by the other, and explores different combinations of protection/disclosure. From this study, it may be concluded that, without proper incentives, the inventor may be not willing to accept a transfer of knowledge towards others. This highlights the importance of policies to support transfer of knowledge.

## 4 Conclusion

In this position paper, we argue that a reflection on the mechanisms that can allow effective knowledge transfer can be useful to understand how innovations can be effectively flow from sources (i.e. developed countries) and receivers (namely, developing countries), and how this can help to identify proper management strategies and public policies. Assuming that this process of innovation transfer is essential for a sustainable and balanced development, it is therefore important to analyse the conditions that can make it successful. Today, IT applications (and, especially, Web 2.0 social networking applications) are of great help for connecting companies and organisations across time and space. However, simply “connecting companies” is not the solution. The use of IT systems can be more or less effective depending on the networking structures within companies and the kind of knowledge flows that occur. Modelling how knowledge can effectively flow from a source to a receiver, and understanding what effects a policy of innovation protection or disclosure can have, are absolutely necessary to implement appropriate supporting policies that can help a balanced economic development. The examples of formal modelling approaches presented here are an essential starting point.

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