

Media Channels for Personal Business Media

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Abstract—Knowledge becomes a crucial production factor that is traditionally sourced from individuals and groups within a firm. In a globalised economic world with products and services of growing complexity, firms are challenged to depend on external knowledge. Hence, knowledge becomes an asset that can be exchanged as traditional goods. Currently knowledge exchanges are manufactured on demand. The key question is, how digital media can efficiently and effectively support knowledge exchanges in economic situations. We will discuss a generic framework for knowledge trading media that homogeneously integrates economic transactions and generic digital services. With this reference model, a means is provided by which knowledge trading can be intentionally designed and analysed.

Index Terms—use maximum 5 index terms.

I. INTRODUCTION

Division of labour creates wealth by actors with specialised expertise and knowledge that creates increasingly improved products and services. Central to this approach are environments and mechanisms that coordinate these actors by innovative forms. Up till now, knowledge was perceived as a private and enclosed property of individuals or firms. Recently it became apparent that knowledge is a central factor in the economic interplay of resources that can be managed and even becomes a target for commercialisation. It is shown that economic actors who optimise their usage of collective expertise and knowledge are likely to be more efficient and effective in marketplaces [1]. Hence, the integrated organisation of information processing and knowledge work on human and technology level intends to create better performances and commercial values [2-4]. Capitalisation on knowledge requires an understanding of why and how individuals and groups exchange knowledge. A central premise of economic analysis and in particular for knowledge exchanges is that people do have well defined interests describable by individual utility functions, and that they seek to maximise their utility [5]. A more precise and historic economic observation is that people can perform better if they specialise and co-operate in their activities of production and then acquire the actual goods and services they desire by transacting with one another [5]. This leads to economies of scale through the specialisation on those activities where one individual has comparative cost advantages in production. But such a specialisation can take place in the realm of market mechanisms allowing to exchange information, goods and services.

II. 2. FOUNDATIONS OF KNOWLEDGE EXCHANGE IN ECONOMIC ENVIRONMENTS

In different situations the work of managers are largely destined by making decisions and solving problems [6] in uncertain environments. According to [7] knowledge is the most sought remedy to reduce this uncertainty. People search for knowledge because they expect it to help them succeed in their work and they try to find knowledgeable people when they see the need to deliver a solution for a problem.

From an economic viewpoint, economic actors are nodes in a knowledge network that optimise their decisions according to utilities that can be gained by exchange of knowledge. This means that two actors exchange knowledge in principle if it provides positive utilities on both sides. Rewards for sharing knowledge are found in reputation, altruism, or reciprocity but in general investigations on economics of knowledge are rather sparse [7]. Following this metaphor of, knowledge is a framed, fluid, and action-oriented object, which is adapted and used by the user according to the situation [7]. Commercialisation of knowledge requires to perceive it as an asset [8]. Extending this view, knowledge assets are fundamental resources of an economic actor to create value (cf. [9]). This indirect definition reflects the problem that it is easier to describe impacts of knowledge than the nature of knowledge itself which leads to a rather artificial discussion on knowing and knowledge [10]. Throughout this article, we will use a pragmatic definition: a knowledge asset of an economic actor is a set of cognitive and technological information processing capabilities that can be intentionally used by economic actors to create value. This definition allows to discuss commercialisation of knowledge by products in form of explicit artefacts or by processes in form of integrating expertise of individuals and groups in problem solving situations. It also encompasses information assets, such as databases or publications as well as human expertise of individuals or groups [9, 11]. Hence, the class of knowledge assets is composed of two sub classes: (1) cognition-based knowledge assets that are bound to human experts and (2) digital knowledge assets that can be explicated and captured by information processing machines.

In this article, we discuss economic foundations (1) for trading of knowledge assets between individuals and groups in and between organisations and (2) current trends in computer science on semantic web technologies that facilitates

knowledge trading what leads towards a media-based framework on knowledge trading media.

III. THEORY

Economic networks are patterns of social relations among economic actors, i.e., firms and institutions. Social relations evolve in communication networks by the influence of exogenous, e.g., job contracts, and endogenous factors, e.g., social ties between actors [12]. Economic actors process knowledge for generating innovations that can be exploited in economic environments [3]. In general, it is a strategic decision of an economic actor to create inside the actor's organisational boundaries (intra-organisational knowledge exchange) or to adopt from accessible, external knowledge networks (inter-organisational knowledge exchange). The division and exchange of knowledge across individuals and groups has been identified as being central to the performance of firms ([29, 60]). For the latter option, studies have analysed different external origins from which firms adopt new knowledge via information flows (e.g., [13]): (1) commercial competitors, (2) commercial non-competitors, (3) public research institutions or (4) by hiring knowledgeable experts [14]. The concept of a knowledge network conceptualises relational aspects between economic actors and other kind of resources [15-17]. Kogut argues that the structure of a knowledge network is an emergent outcome generated by governing rules [18].

As the economic importance of knowledge increases, knowledge exchanges between economic actors are required to become more explicit and organised. The organisation and economic exploitation of knowledge networks by market structures provides means for efficient matching of knowledge supply and demand on individual and group level. Knowledge transactions are part of interactions in knowledge networks that can be conceptualised by media [19] as a place of interactions governed by a language, an organisation including roles, rights and obligations, interactions, and underlying communication and collaboration channels. Governing rules for knowledge transactions can be given by proprietary contractual relationships in cohesive networks (closed knowledge relations) or unrestricted relationships in loosely connected but coherent networks (open knowledge relations) [13]. In both forms of knowledge networks, governing rules organise knowledge transactions on two levels: (1) contractual level and (2) knowledge level. On the contractual level, economic actors define the rules by which goods on the knowledge level are exchanged.

Knowledge assets that can be exchanged are traditionally given by the polar division into explicit and tacit knowledge [3, 20]. It addresses potential forms of transformation whether knowledge can be explicated by artefacts, i.e., transformed into symbols with explicit meanings [20]. Both forms of knowledge are important assets for economically relevant innovations that can be exchanged between economic actors. Knowledge processing of individuals is modelled by methodologies of cognitive science and focuses on memory and cognitive processing capabilities. Knowledge processing in groups extends the individual viewpoint of cognitive science by a social dimensions of how individuals

share knowledge in groups inside and outside of an organisation [21]. Connections that support knowledge exchanges among economic actors can be divided by two concepts [13]: (1) linkages as channels that diffusely and imperfectly direct transfers between actors, facilitating information spillovers that benefit both loosely connected and centrally positioned organisations (weak connections) and (2) closed conduits, characterized by legal arrangements designed to ensure that only the specific parties to a given connection benefit from the information that is exchanged (strong connections).

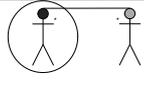
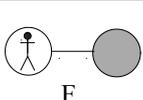
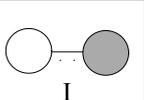
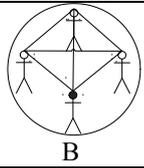
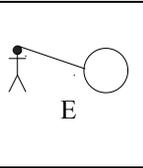
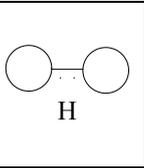
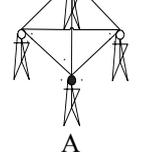
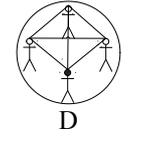
Patterns of Knowledge Exchanges	Individual-to-Individual	Individual-to-Group	Group-to-Group
External Supply	 C	 F	 I
Group Supply	 B	 E	 H
Individual Supply	 A	 D	\emptyset G

TABLE 1: PATTERNS OF KNOWLEDGE EXCHANGES

It is argued that the social identity of an economic actor largely stems from the capability to create, replicate and therefore accrue tacit and explicit organising principles at work [18]. Direct economic returns are gained by economic actors that commercialise knowledge, such as media firms and consultancies. In the former case, knowledge exchanges are not controlled on the level of single events but overarching contractual agreements and by net gain approximation such as increase of patents over time [13, 22]. In the latter case, knowledge is packaged by artefacts or provided by cognition-based services. With the rise of digital communication networks, digital knowledge assets have been attributed by the notion of a good that can be exchanged, branded, and traded [7, 23]. Nevertheless, the marriage of knowledge assets and digital media provides characteristics that enables innovative exploitation forms of frictionless floating knowledge assets [7]. This in turn affords that knowledge assets can be object of economic transactions. Hence, a knowledge asset is commercialised knowledge which obtains characteristics of a good that can be target of economic contracts. Relative to conventional cost-based pricing, pricing strategies on electronic marketplaces for digital knowledge assets significantly differ in respect of production, distribution, delivery, payment and consumption [24].

More complex knowledge types and in particular pro-

cedural knowledge of problem solving had been target of research on Expert Systems that still lack maturity [25]. By merging database approaches, distributed systems and approaches in semantic networks, an integrated field called semantic web has been founded that targets to make information sources more readily accessible to automated processes by adding meta-information that describes provided information [26, 27]. Automated processing and reasoning requires that meta-information is formalised which is approached by using ontological representation formalisms such as OWL [28]. Ontologies extract important concepts and relations in a domain of a digital knowledge asset. Ontologies provide a means to gain precise and formalised information on knowledge assets without accessing it.

IV. KNOWLEDGE TRADING IN GENERAL

In the following, the focus lies on digital knowledge assets, also called information goods [23]. In general, information is economically valuable if it directly or indirectly contributes to solving an economically relevant problem [23]. Adopting Newell and Simon's definition, problem solving based on means-end analysis identifies differences between the current state and the goal state and selecting operations that reduce these differences [29]. The precision of the problem description determines the efficiency by which solutions can be found. In a group this mutually shared understanding requires shared knowledge between group members. Hence, a problem statement is already a result of a knowledge processing task. The work situation of a problem statement determines the context in which it is evaluated. In different contexts different (1) social relationships, (2) resource limitations, (3) languages, (4) organisations, (6) methods and (7) services for solving a problem can be used [30, 31].

Whether in a specific work situation an economic actor can satisfy his demand by adopting external knowledge supplies is a question of internal and external resource limitations [32, 33]. Finding a knowledge supply for a knowledge demand is a multi-stage problem solving task itself. On the first stage, an economic actor tries to satisfy knowledge demands with directly available expertise or information sources (individual knowledge supply) that is based on mental representations [34] or organisational memories. The next stage consists of accessing remote knowledge sources (organisational knowledge supply), i.e. via other experts or information sources of the firm (external knowledge supply). This multi-stage problem solving model is determined by blended knowledge network structures of demanding economic actors and all actors accessed by a corresponding requests. From the viewpoint of an organisation, three organisational entities can be dissected: (1) individuals, (2) embossing organisation and (3) external organisation. Embossing organisations are those that completely or partially embed knowledge demanding economic actors. Relationships between these three entities are either (1) individual-to-individual, (2) individual-to-group or (3) group-to-group relationships. While a group is defined as a set of individuals with direct working relationships that are governed by a homogeneous set of contracts between all group

members. In general, formal and social relationship networks exist independently from each other but they might overlap in parts or even in total. It is argued that knowledge is more easily transferred within organisations, such as a firm, than across firms [35]. In general, knowledge exchange between actors is influenced by past history of exchanges, by cultural issues of the organisation and trust relationships [36].

In the first relationship category (individual-to-individual), three generic patterns of knowledge exchanges can be identified (cf. table 1). In a group that obtains no explicit contracts between individuals, knowledge exchanges rest on the personal social ties of all individuals (A). This kind of relationship pattern is commonly termed "personal network" of an individual. Pattern B includes knowledge exchanges in a group that is governed by explicit contracts. Exchange between individuals with others outside pattern A affords explicit contractual relationships (C).

The second relationship category encompasses individual-to-group relationships. Individual supply of knowledge to an individual in a group that is governed by an explicit contract is equivalent to pattern B (pattern D). Exchange relationships between an individual and a group that share a homogeneous set of overarching contracts but that determined an explicit contract for knowledge exchange is pattern E. Pattern F are traditional relationships of individuals with external knowledge supply groups. Pattern G does not exist by definition whereas patterns H and I are extensions of E and pattern F with a group-to-group relationship. Patterns A, C, and E are long-term, emerging social networks of an individual (social relations) whereas patterns B, D, F, H and I are dominated by formal relationships that are given or defined by organisational settings in which an individual is currently working (formal relations). Social relations are more sustainable for individuals whereas formal patterns are more sustainable for organisations. In general, social relations of non-commercial knowledge exchanges support networks between economic actors.

Formal relations are organised by dedicated entities of an organisation. They are due to contractual and therefore commercial relationships with internal or external economic actors. For instance, in patterns B and D, a contract is given by a project description in which resources are planned that contribute to the knowledge demand of the project. For pattern F, the organisation will negotiate a contract with an external expert, such as a specific consultant.

In reality knowledge exchange patterns are not mutually exclusive but overlap. If social relations between individuals dominate, the network will tend to focus on knowledge sharing whereas a dominance of formal relations tends to lead to knowledge trading. In summary, knowledge exchange behaviour can be dissected into knowledge sharing or knowledge trading behaviour. The boundaries between both behaviours and derived economics are blurred so that our investigation on knowledge trading also provides insights on knowledge sharing. In the following we will discuss a generic reference model for knowledge trading media that will pave the ground for business models for know-

ledge trading in the realm of electronic markets.

V. KNOWLEDGE MEDIA REFERENCE MODEL

Cooperative actors which exchange goods and services require a medium as an environment for communication and collaboration. A medium consists of (1) channels for communication and collaboration, (2) a mutually shared logical space by which information can be interpreted and (3) an organisation which governs roles and interactions that can be used in a medium [19]. From this viewpoint, economic transactions in electronic markets intentionally change the states of economic actors in at least four components: (1) knowledge on the economic situation and tradable goods and services, (2) intentions that can be signalled, (3) contractual agreements and (4) reservoirs that contain resources (e.g., finance, goods and services) that can be traded ([45]).

The proposed reference model for media that facilitate trading of knowledge, in short knowledge trading media, intends to understand different interaction patterns of different economic actors by formalised models which facilitate guided designs and analysis of knowledge trading situations [19]. The approach consists of four conceptual views that describe interactions between economic actors along generic phases of a transaction: (1) community view, (2) implementation view, (3) transaction view, and (4) infrastructure view. The community view models the organisation of a medium with roles, rights, obligations. The service view describes services that are given by the underlying infrastructure. Services are described by service access points such as libraries or payment services. Services are implemented in an infrastructure, be it technical or human centered. The implementation view organises the procedural interactions between actors and services. Interactions can either be given by explicit descriptions such as processes or by implicit descriptions as given by social rules.

A. Transaction Model of Knowledge Trading

A generic transaction model that facilitate knowledge trading is derived from the general economic market model [37]. Market transactions are aggregated activities that are designed to efficiently support optimal equilibria of economic needs of participating economic actors. Generic transactions can be divided into four phases: (1) information phase, (2) signaling phase, (3) agreement phase, and (4) execution phase [19]. In the information phase, an actor on demand side obtains assertive knowledge from a particular community in the form of facts. Retrieved and shared information is incorporated by an economic actors by appropriate representations that evolves over time. During the signaling phase an actor indicates this interest so that both parties enter the negotiation phase or terminate the interaction. By the negotiation phase actors communicate and design contracts by means of electronic communication [19]. Electronic contracting represent terms and conditions of a contract and a means for monitoring of contract performance. On the basis of harmonised international commercial law, contracting services will displace human judgment and interventions to a large extent. At the eve of fully automated

electronic contracts, we will distinguish between explicit and implicit contracts. Explicit contracts are fully formalised and assertive in a particular knowledge trading situation. In contrast, implicit contracts are grounded either in social agreements that are not explicated in the situation of a knowledge transaction or in overarching explicit contracts that are not used in the particular knowledge transaction. Therefore, the difference between implicit and explicit contracts is the level of ambiguity. The result of this phase is a binding contract including obligations and rights on both sides as far as they are not already defined by overarching contracts. If the situation is dominated by social ties contracts will be implicitly defined whereas formal relations of knowledge exchange situations tend to use explicit contracts. The execution of contracts is performed during the execution phase in which information is exchanged against direct or indirect values (reputation, altruism, reciprocity [7]). The result of this phase is the correct termination of a business transaction, i.e. a successfully executed contract or a mutually agreed form of cancellation of the transaction.

This generic transaction model applies to all eight knowledge exchange patterns (cf. table 1). The main difference occurs by the explicitness of contracts. Patterns A, B, D, E and H are governed by overarching contracts inside an organisation so that single knowledge transactions are executed with pre-existing boundaries. Examples are personal networks, project teams, communities of practice and merged firms. Explicit contracts are negotiated in situations of patterns C, F and I which implies network externalities for these situations. Organisations with overarching contractual frameworks profit from explicit contracts if implicit, overarching contractual agreements will be made explicit by electronic contracts that will nurture enormous positive impacts on organisations.

B. Community View

In a simple knowledge trading media only few roles are required on community level. For pattern A, two roles enter a medium: demand and supply. Marketplace media (patterns F and I) predicts more organisation and therefore more roles. In general, a knowledge exchange medium includes eight generic roles: (1) expert, (2) publisher, (3) reviewer, (4) broker, (5) demand, (6) confident, (7) escrow, and (8) arbitrator. The role of an expert is taken by actors with reputation in an area of expertise which the demanding actor considers as being relevant for solving the problem. Information issued by the expert is packaged and offered by the publisher on the market. In less formal relations of knowledge sharing, expert and publisher are taken by a single actor. The role of a reviewer evaluates knowledge assets and provides a quality signal. A broker knows about supply and demand for knowledge and orchestrates connections between experts and demanding actors. A broker can simply adopt a marketplace-creating role or offer more advanced services for matchmaking such as intermediating functions. In structured knowledge trading situations with the need for formal contracts additional roles can be introduced. The confident saves a legally binding copy of the contract between the exchanging parties. The role of an escrow is taken

if information goods are to be rewarded in trust ("in escrow") until particular contractual conditions are met. An arbitrator is chosen by the contracting parties to decide on contractual disputes.

C. Service View and Infrastructure View

Efficient and effective implementation of knowledge trading transactions aspire to be fully automated by electronic services. Traditionally the information phase is supported by (federated) electronic product catalogues that facilitate services for translation, integration and differentiation [38]. With the discussion on semantic web technologies the question arises how product catalogues can be enriched by semantic annotations that improves search and aggregation of information goods. Ontology-based library services are catalogues for knowledge assets with a directory of structural information on listed knowledge assets (meta information). Meta information provided by ontology-based catalogue services are based on taxonomic representations or formal representations. The first class encompasses tree-structured keyword lists. Keywords represent main concepts of the knowledge domains in which knowledge assets are defined. Taxonomic services provide practical means for efficient analysis of information goods by human actors. Because taxonomies depend on inclinations of the taxonomy designer they require interpretation and expertise in the domain so that they cannot be fully automated without ambiguities. Light ontologies, such as RDF, link concrete syntax with formal semantics on graph-based data models. They are successors of traditional description logic approaches. RDF-based approaches, such as OWL, extend syntactic interoperability to semantic interoperability by providing a set of shared and precisely defined terms ([22]). With the logical basis of these languages, reasoning services, such as discussed by ORL [39], can be provided that support enhanced services such as syndication, modification, selection and adaptation of information goods according to resource limitations and other demand requirements.

The core element of the signaling phase is that the demanding actor and the supplier initiate a direct contact and signaling their starting positions for the negotiation phase. Traditionally this phase is covered by catalogue services [40]. Compared to human-centered situations the signaling phase facilitated by digital services is rather simple. In general, digital services provide explicit descriptions of initial offerings.

Signaling services set the context from which the negotiation phase starts. Access to knowledge assets might be restricted by overarching contracts, such as given by membership contracts. Overarching contracts are used for the qualification of demanding actors by (1) individualisation, (2) by assessment of individual or group-related attributes or by (3) validation of electronic contracts. Simple forms for these qualification mechanisms are profiling, analysis of merits as in Open Source Software communities, and registration. With the rise of business networks signaling services might be extended to more complex services, similar to job interviews.

By the negotiation phase, actors negotiate requirements on knowledge assets and terms of contract performance. Contracting services support processing on both levels [41]. When fixed pricing schemes are used, the negotiation phase is trivial by accepting or declining the initial offering of a supplier. Complex knowledge sharing situations such as those in patterns I and E afford sophisticated negotiation services that are only available in highly structured environments, such as given by stock markets. Property rights define the individual's rights in dealing with a product. The assignment of property rights creates for the beneficiaries and activity restrictions for those agents having no property rights on the respective good at their disposal. The property rights of a good can be divided into four single rights [42]: (1) right to use the product (*usus*), (2) right to change the form and substance of a product (*abusus*), (3) right to reap the profits from a product, respectively to bear its losses (*usus fructus*) and (4) right to sell the product to a third party (right of liquidation). Beside property rights, explicit contracts determine the mode how knowledge assets are provided: (1) contracts on knowledge assets that already exist (use-contracts) and (2) contracts on knowledge assets that are created on demand (create-contracts). Complete electronic contracts include binding signatures, preconditions and post-conditions and a task description that fulfils this contract. A task description can be represented by a deterministic finite state automaton. In use-contracts these task descriptions target the logistics between relevant roles. More complex are explicit task descriptions of create-contracts. Functional requirements of an information good are described by preconditions and post-conditions. Procedural requirements how a knowledge asset is to be created are described by task descriptions. The execution phase controls the execution of electronic contracts. Analogue to a program, an electronic contract is called correct if and only if it halts and the preconditions combined with the conditions arising from execution lead to the post-condition. The execution of implicit contracts are governed by social rules whereas explicit contracts require explicit procedures. Digital services for the execution phase are logistic services and, for create-contracts, services which allow tracking of knowledge asset creation and matching with contractual requirements. Financial logistics and delivery services for knowledge asset are the basic services for the execution phase. Tracking services for knowledge asset creation are rarely standardised. Ideas can be borrowed from project management suites.

VI. SUMMARY AND OPEN ISSUES

Temporally and geographically distributed work affords innovative forms for communication and collaboration. Knowledge, as an important factor in this economic world, needs to be seen as a production factor and a product itself. Seamless exchanges and processing of knowledge affords electronic media by which knowledge assets can be evaluated, traded and accessed for use in innovation and processing tasks. With the media reference model for knowledge media, we propose a framework by which new designs and analysis of existing implementations can be formalised and

guided. It shall be taken as an initial attempt for a formal theory on knowledge media, that requires further research in cooperation with research in social and organisational sciences on knowledge work and knowledge networks, as well as research in the realm of computer science. It will become particularly valuable to empirically investigate changes in performance by media designed within the bounds of the media reference model for knowledge trading.

VII. REFERENCES

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