

Why serendipitous informal knowledge sharing interactions are key to boundary spanning and creativity

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Abstract.

BACKGROUND: Informal Knowledge Sharing Interactions (IKSI) are particularly valuable for innovation projects if they connect partners who are categorically, socially and formally distant from each other. Then the chances are higher that partners possess non-redundant knowledge and can thus open up new perspectives. By improving their knowledge supply, IKSI enhance the success, job satisfaction and well-being of employees in knowledge-intensive industries. So far, however, it is unclear how such interactions between heterogeneous partners emerge.

OBJECTIVE: The paper examines the formation of IKSI and develops the argument that serendipitous IKSI are more likely than planned IKSI to connect heterogeneous partners and open up new perspectives.

METHODS: The paper develops the argument in detail and empirically grounded by drawing together the unconnected literatures on the formation and impact of IKSI. Furthermore, the argument is empirically tested using 132 IKSI from developers collected with event-based diaries.

RESULTS: In line with the conceptual work, the empirical analysis shows that serendipitous IKSI are more likely than planned ones to open up new perspectives.

CONCLUSION: Serendipitous IKSI are of particular significance and require appropriate promotion in order to enhance innovative capability. The increasing virtualization of work is creating opportunities and challenges in this regard.

Keywords: Innovation, communication, informal interaction, boundary spanning, knowledge sharing

1. Introduction

Innovation projects are characterized by a high and dynamic knowledge demand. Informal knowledge sharing interactions (IKSI), in which colleagues voluntarily provide their knowledge to solve the tasks of others, have proven to be the most important source for this [1–3]. They enable the efficient and timely identification and acquisition of relevant knowledge. Thereby, IKSI enhance the job satisfaction and well-being of employees in knowledge-intensive industries [4, 5]. Furthermore, IKSI have proven to be an important driver for the success of innovation projects. While early research focused on the number of IKSI, more recent work points more strongly to the

importance of partner constellations. Beneficial are especially the IKSI, which involve colleagues who hold knowledge and competencies that are comparatively distinct from their own. It is argued that IKSI between heterogeneous partners are more likely to convey non-redundant knowledge and thus open up new perspectives on the own project. They thus make a particular contribution towards discovering further development paths for innovation projects and thus increase their chances of success as well as the job satisfaction and well-being of the responsible employees [4–7].

Against the background of their considerable impact, innovation research has intensively investigated the formation of IKSI. Thereby, robust

formation mechanisms with high explanatory power have been identified [8, 9]. By applying these, the social, formal, and material embeddedness of individuals can be used to explain which colleagues are likely to involve each other through IKSI. Further, these insights are used to stimulate the formation of IKSI in practice. While recent research on the effect of IKSI emphasizes the heterogeneity of interaction partners, this has not yet been taken into account in explaining their formation. On the basis of existing theory, it is therefore not possible to explain the particularly valuable IKSI among heterogeneous colleagues. In this paper, I will argue that IKSI between heterogeneous interaction partners emerge in a systematically different way than those between similar ones. Given these differences, IKSI and the advice networks they constitute can be explained and stimulated in a more nuanced way.

The basic argument of the paper is derived from the literature on serendipity. In innovation research, serendipity describes the phenomenon “that researchers make unexpected and beneficial discoveries” [10]. The serendipity literature emphasizes that researchers who focused on a specific problem found its solution not solely through systematic research activities, but remarkably often as a result of unplanned incidents [11, 12]. Besides accidentally triggered chemical reactions, this literature also anecdotally refers to unplanned interactions as incidental impulses for innovation. In this paper, I take up this idea and make the case that *serendipitous informal knowledge sharing interactions* (SIKSI) are significantly more likely than *planned informal knowledge sharing interactions* (PIKSI) to connect heterogeneous interaction partners and, accordingly, are more likely to provide non redundant knowledge and thus open up new perspectives. To unfold the argument, I will shed light on the mechanisms identified to explain the formation of IKSI, asking in each case (1) to what extent they produce SIKSI or PIKSI and (2) whether similar or heterogeneous interaction partner constellations are to be expected. The analysis of the concepts refines and corroborates the argument. It shows that a bias towards local search leads PIKSI to bring together colleagues with similar knowledge and skills, while SIKSI break this bias and thereby produce more heterogeneous partner constellations. The main aim of the paper is to develop the theoretical argument by systematically integrating two unrelated strands of research. Besides, it finally provides a first empirical investigation of the argument. Based on the analysis of 132 IKSI related to product development

projects at large companies, it is confirmed that SIKSI are significantly more likely than PIKSI to open up new perspectives.

2. The interactive development of innovation

Already the founders of innovation research pointed out that innovations usually result from the successful recombination of existing knowledge [13, 14]. In this way, they emphasized that successful innovations cannot be attributed so much to the unrestricted course of a free creativity, but rather require detailed knowledge and competencies. This assumption is also shared in current creativity and innovation research [15, 16]. On the other hand, a significant difference exists with regard to who conducts the knowledge combinations. Whereas Schumpeter in particular focused on creative individuals, current innovation research shows that innovative knowledge combinations are primarily produced interactively. Because the expertise of individuals is usually limited to one or a few specific areas, the possibilities for novel combinations in the area of their knowledge are limited. In contrast, comparatively many new combination possibilities arise when individuals with different expertise combine their knowledge interactively. Interactions between individuals are therefore key to the development of innovations [17–19].

While the sharing of knowledge in basic research is conducted to a greater extent in written language, the development of novel products, services and processes in enterprises is characterized in particular by verbal knowledge sharing interactions, which are less precise but take significantly less time [20]. The interactive acquisition of knowledge and competencies from colleagues can significantly improve the (low) chances of success of innovation projects. Developers in companies are concerned with developing and prototyping ideas with innovation potential. At the beginning, the ideas are usually abstract and it is very uncertain whether they can actually be realized and successfully marketed [21, 22]. The task of developers is therefore to make ideas tangible. This requires creativity. To find the best possible path for development, developers must discover a wide variety of approaches and pursue alternative paths to test their suitability. On the one hand, development is an ongoing creative process that benefits from identifying as many potential paths as possible. On the other hand, because resources are scarce, selection is omnipresent. Individual development paths as well as

entire innovation projects are continuously reviewed, retained or discarded [20, 23]. Both the identification of development paths and the selection of the most promising ones benefit significantly from additional knowledge and perspectives.

Such knowledge sharing interactions take place in a formal context between the members of an innovation project team and their superiors [24–26]. However, it has been shown that developers also engage in informal knowledge sharing interactions (IKSI), in which colleagues voluntarily provide their knowledge to solve the tasks of others together. The informal nature of these interactions means that there is no formal reason for the committed colleagues to contribute to the projects of others and that no working time is available for this purpose. The fact that they nevertheless take place and are so important has three main reasons.

First, the efficient handling of projects requires the smallest possible number of project staff. This keeps coordination costs low and avoids overburdening individual employees through parallel involvement in a large number of projects [27]. The perspectives represented in a project are therefore limited from the outset by the number of people involved. Second, innovation projects are characterized by a particularly high degree of fuzziness [28]. Precise activities are defined in the project on the basis of the current state of knowledge and, because this changes, are adapted again and again. As a result, at the start of the project it is very difficult to foresee which specific knowledge will be relevant later on. The specific knowledge required for the projects only becomes apparent during the projects. Staffing the projects with the most suitable developers is therefore only possible to a very limited extent, because it is unclear what knowledge will be required. Through IKSI the relevant knowledge for the project can be obtained. Third, the capacities of developers (and most other employees in a company) are allocated to projects in the medium term [23]. If it is recognized in the course of a project which specific knowledge is relevant to it, it is likely that the corresponding knowledge carriers will be unavailable at the moment. Since the success of projects also depends on whether developments can be completed faster than competitors, waiting for a specific expert to become formally available is usually not an alternative. The efficient organization of development processes in companies is therefore only compatible to a very limited extent with formally integrating the broadest possible spectrum of relevant knowledge carriers into projects. IKSIs make it

possible to satisfy this need and thus crucially contribute to the success of innovation projects [20, 29–31].

3. Which interactions are particularly beneficial for innovation?

In line with what has been said so far, research further shows that not all IKSIs are equally beneficial for innovation projects. Of particular importance here is the extent to which the knowledge stocks of the interaction partners are complementary. In the research on the relationship between the heterogeneity of knowledge stocks and innovation successes, two findings in particular have proven instructive.

First, differences between the knowledge bases of individuals and organizations are described as cognitive distances [17, 32, 33]. The larger this distance turns out to be, the smaller the overlaps between the knowledge stocks are. Applying this concept, it is stated that a low cognitive distance is not very fruitful because the potential for learning from each other and recombining knowledge is low. On the other hand, a very large cognitive distance causes communication difficulties that can create a great effort and bring the exchange of knowledge to a breakdown. A medium cognitive distance is therefore considered particularly promising. It characterizes a state in which the knowledge stocks of the interaction partners are on the one hand connectable, so that interaction partners can communicate without major difficulties, and in which they are on the other hand still so different that there is potential for learning and recombination.

Second, differences and similarities are placed in a relationship to the concrete task instead of only considering the knowledge stocks per se. Based on this distinction, it appears that interaction partners who have different task-related knowledge and are otherwise alike are best positioned to successfully accomplish the complex innovation tasks [34–36]. However, it is also reflected here that in the case of innovation projects, it is highly unclear what knowledge needs to be combined to be successful. Therefore, a wider range of differences is also considered more fruitful here.

The presented literature is characterized by a high level of abstraction. In research on IKSIs, the causal relationships can be simplified through greater contextualization. This concerns both the optimal heterogeneity measure and the empirical identification of heterogeneity. It follows from the foregoing that

IKSI promise to contribute to the success of innovation projects when the knowledge bases of the interaction partners have both similarities and differences. In this context, it is significant to reflect that IKSIs take place first and foremost among colleagues within an organization. Since specific organizations attract only certain individuals, and only certain individuals are hired and remain, the employees of an organization are typically characterized by a comparatively high degree of homogeneity [37]. This is further enhanced by the fact that employees in organizations share knowledge interactively with each other, thereby assimilating. IKSIs therefore tend to benefit from a relatively high heterogeneity of interaction partners rather than risk suffering from it. In research, therefore, the value of heterogeneity is emphasized foremost [1, 36, 38].

A particular challenge for research on heterogeneity of IKSIs partners – also as a result of the comparatively high homogeneity of employees in an organization – is to empirically capture differences in knowledge stocks. Due to the high complexity, it is not possible to directly determine the knowledge stocks of interaction partners using established methods. Therefore, it has proven useful to approximate heterogeneity by means of more easily ascertainable factors. Three approaches have proven to be particularly valid.

First, more easily accessible characteristics of individuals such as the disciplinary classification of their degrees are seen as markers of specific knowledge stocks. Apart from the fact that individuals received a corresponding imprint through their disciplinary education and thus possess subject-specific knowledge, competencies, and perspectives, it is pointed out here that even the choice for a subject implies a strong preselection. Accordingly, students from different disciplines differ systematically even before they start their studies, and this is also true with regard to their knowledge and perspectives. Unsurprisingly, research proves that categorical heterogeneity is related to the heterogeneity of knowledge stocks and that interaction relationships between individuals who are heterogeneous in this sense show the expected innovation-promoting effects [38, 39].

Second, the heterogeneity of knowledge stocks correlates with their embeddedness in social structures. This argument was first formulated by Granovetter [40]. He argues that non-redundant knowledge can be expected to be more likely when interaction partners do not maintain close relationships but are connected by weak ties. This is based on the

assumption that individuals who maintain strong ties are also likely to have similar knowledge and perspectives because they probably interact more frequently and have the same or similar sources of information. The basic argument has been refined by Burt [41] in terms of network analysis. In contrast to Granovetter, however, he looks not only at individual ties or networks of individuals, but at the totality of relationships of specific circles of individuals (e.g., members of an organization). He finds that clusters are formed within these circles. Constitutive for clusters is that individuals who maintain a relationship also maintain relationships with the same third persons. Accordingly, the ego networks of individuals in a cluster are to some extent alike. Because they have the same contacts, the individuals' knowledge and perspectives are also similar. Furthermore, the tendency to align is promoted by dense relationship networks in clusters, since social control and subsequent social pressure to conform is stronger on each individual in such. Divergent views are therefore more likely to be held back and the development of different perspectives is impeded [42–44]. Within clusters, therefore, there is a relatively high degree of homogeneity with respect to the knowledge and perspectives of the actors. The formation of clusters is accompanied by the formation of structural holes, which are characterized by the absence of relationships between individuals belonging to different clusters. Burt thus notes that individuals belonging to different clusters are likely to have reasonably different knowledge and perspectives, and that bridging structural holes is therefore likely to lead to non-redundant knowledge [6, 45].

Third, the heterogeneity of knowledge stocks correlates with their formal structural embedding. Comparable to the argumentation on the importance of social structures, it is argued here that knowledge is shared to a greater extent within organizational boundaries (e.g. in departments) than between different organizational units. Here, too, both a higher concentration of interaction, incentive mechanisms rooted in hierarchies, and employee (self)selection processes ensure a homogenization of knowledge stocks. The interactive bridging of formal boundaries, referred to as *Boundary Spanning*, therefore leads to non-redundant knowledge and is therefore particularly fruitful for innovation projects [30, 46, 47].

In summary, research shows that IKSIs between individuals who differ categorically, socio-structurally, and/or formally are particularly fruitful for innovation projects because they are likely to connect

individuals who have different knowledge stocks. There is therefore the potential to learn from each other and recombine disconnected knowledge to solve complex problems and create innovations.

4. Who turns to whom for IKSI?

While research clearly shows that IKSI promise to provide crucial impulses for innovation projects especially when the interaction partners differ from each other categorically, socio-structurally and/or formally, it is unclear how exactly such constellations are formed. Although a rich body of research exists on the formation of interactions, it does not distinguish between the formation of homogeneous and heterogeneous interaction partner constellations. In the absence of this distinction, it is not possible to explain how the particularly beneficial IKSI between heterogeneous partners come about. However, it seems extremely desirable to resolve the question of how they come about, because this would enable more far-reaching explanations of innovation processes and stimulation of the fruitful interactions in practice in a more systematic manner than before. Stimulation has great potential, mainly due to the fact that (in contrast to research-based recommendations and partly contrary to the conviction of the practitioners) mainly homogeneous IKSI partner constellations are formed in practice and heterogeneous ones are rather the exception.

Following the literature on serendipity, I hypothesize that heterogeneous interaction partner constellations are formed primarily through serendipitous informal knowledge sharing interactions (SIKSI). SIKSI are characterized in that the interacting individuals did not plan them and just make them happen, but that their occurrence was linked to conditions beyond the control of the individuals. PIKSI are for example such IKSI, which result from a colleague, who was chosen as interaction partner in advance, being deliberately approached or a corresponding meeting being arranged with this colleague.

In line with the concept of serendipity, I do not assume that SIKSI strike people completely without their involvement [12, 48]. Serendipity research has highlighted that unplanned discoveries are usually accompanied by the discoverers being on the hunt. Accordingly, I assume that although SIKSI are not concretely planned and in a sense arise, there is certainly a fundamental interest in impulses about a particular problem that occasionally becomes

motivating for action when an opportunity arises [11, 12]. For example, an interaction is still a SIKSI when a developer already had the idea that a certain colleague could help him or at least that it might be helpful to talk to someone about it, but the concrete interaction resulted from an unplanned encounter. Furthermore, serendipity research emphasizes that events do occur unpredictably and unplanned for the discoverers. However, they are not random in the sense that they are completely unexplainable. Rather, it is assumed that they do occur systematically and that the corresponding patterns can be worked out scientifically. This is also true for SIKSI. As I will discuss further, the formation of these is influenced, for example, by spatial structures that explain who is likely to encounter whom unplanned. Even if these encounters appear random to the individuals involved, they arise systematically and can be explained on the basis of the corresponding scientific analyses [12, 48].

I argue that SIKSI, rather than PIKSI, connect individuals who are categorically, social-structurally, and/or formal-structurally distinct from each other. Previous research on the formation of ISKI has not distinguished the partner constellation in this sense. To develop the argument, I will apply the conceptual distinction between SIKSI and PIKSI introduced here to the state of research on the formation of IKSI. To do so, I hypothesize that PIKSI are highly attributable to partner selection decisions, while SIKSI are less attributable to such decisions and more to opportunities. I will show that the decisions shaping PIKSI have a strong bias toward local search. Specifically, colleagues prefer each other as PIKSI partners when they are categorically, social-structurally, and formally close. In contrast, I will show that the mechanisms explaining SIKSI are decoupled from these biases to a greater extent, thereby favoring the involvement of colleagues who are less close categorically, social-structurally, and formal-structurally. In what follows, I will discuss the different mechanisms and shed light on the extent to which they contribute to the homogeneity/heterogeneity of interaction partners. I will first discuss the choice-based mechanisms that explain PIKSI and then the opportunity-related mechanisms that are central to the explanation of SIKSI.

4.1. Choice-based explanations of IKSI

IKSI are motivated instrumentally, insofar as the initiating individuals strive to get the most helpful impulses for their innovation projects. However,

research on the selection of partners clearly shows that the attribution of competence is influenced by factors that are not correlated with competence and that individuals also take other interests into account when selecting partners and initiating IKSIs and thus apply less performance-related criteria.

“Based on comments made by a few respondents in the qualitative phase of this study, we had anticipated that managers would construct their personal networks so as to be able to draw upon a portfolio of skills across many different individuals with complementary skills. This does not appear to be the case.” [49]

Against the background of the findings on the fertility of heterogeneous interaction partner constellations, the choice of partners with redundant knowledge seems surprising at first. However, based on what we know about the mechanisms underlying partner choice, this tendency can be well explained [8, 9]. In the following, I will present the mechanisms and analyze how they affect the formation of IKSIs between categorical, social-structural, and formal-structural heterogeneous individuals.

4.1.1. Social categorization and homophily

In research on social categorization, it is assumed that individuals define themselves and others on the basis of socially established categories [50, 51]. Examples of often relevant categories are the characteristics of dimensions such as age, gender, organizational position, or professional background. Furthermore, affiliations to formal organizational units or informal cliques, for example, are used as categories. The categorization of self and others influences the selection of IKSIs partners in two ways.

Developers usually identify with their capabilities and are interested in their reputation as competent colleagues. In principle, IKSIs bear the risk that problems and faults in their projects will become apparent to others and their reputation suffers accordingly. In the case of PIKSIs, which presuppose open request, the impression can arise that the asking developers urgently need the advice of their colleagues, in order to accomplish their own work [52, 53]. The developers' expectations about whether a colleague is willing to use the disclosed vulnerabilities to embarrass the asking developer in order to promote himself at his expense are therefore a crucial criterion in the selection of the PIKSIs partner. Thereby, personal experiences with the respective colleagues is of great importance. In addition, however, trust in the

benevolence of colleagues is systematically influenced by whether they share social categories with each other. The more categories (with which individuals identify) colleagues share, the more likely they are to trust each other [54–56]. The rationale for this is that it makes them seem more familiar and more likely to feel a sense of connectedness. Shared categories thus induce trust between individuals and increase their propensity to choose each other as PIKSIs partners.

The trust-building familiarity that takes effect here further fosters the impression of being able to understand each other better. Particularly in the case of professional categories, it is likely that this impression has been confirmed and corroborated by relevant experience. Beyond the technical knowledge of different disciplines, however, they often differ in terms of terminologies, values, basic assumptions, and forms of presentation. Differences in this respect can make communication considerably more difficult and also cause that contributions made in a foreign style are systematically valued less [55]. There is therefore a tendency to attribute less competence to colleagues with other disciplinary backgrounds than to those who are assigned to one's own discipline and further to build on corresponding expectations when choosing IKSIs partners [57, 58].

Colleagues who share categories with each other therefore tend to prefer each other when choosing IKSIs partners because such are systematically trusted more and ascribed higher competence [58, 59]. This results in adverse selection in that the underlying mechanism counteracts all three forms of heterogeneity found to be favorable. Both the sharing of personal characteristics (and, in particular, specific disciplinary background) and common membership in social and formal units constitute similarities that structure the selection of PIKSIs partners. Accordingly, the tendencies founded therein counteract a categorical selection that is heterogeneous in terms of social and formal structure.

4.1.2. Established (exchange) relations

Strong personal ties among colleagues are another important factor in the choice of IKSIs partners. Such ties are the product of past interactions and operate by shaping expectations about future interactions, which individuals use to guide their current interactions [60]. Strong ties between individuals accordingly manifest themselves in rich knowledge about each other. This knowledge influences IKSIs partner choice in three ways.

Individuals' knowledge about others is the basis for choosing interaction partners [61–63]. Individuals who are not known to them at all, or whose competencies are not known to a sufficient degree, have little or no chance of appearing as suitable IKSI partners to a developer seeking advice. Since the problems developers encounter are usually very specific, the deliberate selection of an IKSI partner presupposes a comparably detailed knowledge of their skills. This is especially given when colleagues know each other well and maintain strong ties. Strong ties between colleagues thus firstly promote the formation of IKSI between them because they have a better chance of appearing as suitable partners due to their richer knowledge of their competencies.

Second, knowledge of others refers not only to their specific technical knowledge, but also to their thinking and communication style. Individuals who maintain strong ties to each other are, on this basis, able to understand each other more easily and thus to comprehend each other's thinking more reliably and in greater complexity. Because IKSI are complicated forms of interaction in which both problems and proposed solutions require precise understanding of complex interrelationships, knowledge of each other's thinking and communication styles is extremely helpful because it can reduce additional problems of comprehension. IKSI between individuals connected by strong ties run more smoothly and are thus experienced as more satisfying [64, 65]. Based on this experience, corresponding expectations for future interactions with the individual are formed and individuals who are closely connected tend to prefer each other as IKSI partners [3, 8, 65].

As already described, IKSI are thorny in that they bear the risk of appearing less competent. The exchange-theoretical analysis of IKSI has shown that such an impression is associated with a loss of status and self-esteem. Furthermore, the studies building on this theory have shown that especially asymmetric exchange relationships constitute low status and self-esteem for those providing less. Thus, if a colleague takes a great deal of advice from another without conversely being sought as an advisor, low status and self-esteem result. Individuals therefore try to avoid such asymmetric exchange relationships. Accordingly, empirical research shows that advice is preferably sought from those who have asked for advice themselves in the past. As a result, reciprocal exchange relationships often emerge in that individuals repeatedly ask each other for advice and

thereby develop strong exchange relationships with each other. This research shows that the established and reciprocal exchange relationship leads individuals to repeatedly prefer each other as IKSI partners, highly independent from the competence of the contact person, because they are confident that they will not jeopardize status and self-esteem by doing so [53, 66, 67]. Strong exchange relationships are therefore the third explanation for the preference for strongly tied IKSI partners.

Taken together, strong relationships between colleagues account for the tendency to attribute appropriate competence to them, to expect smooth and satisfying interaction, and to avoid jeopardizing self-esteem and status. Individuals thus tend to prefer IKSI partners with whom they maintain strong relationships. Accordingly, partner selection decisions are more likely not to lead to interaction between colleagues who are connected by weak ties, thereby creating a tendency for social-structurally local search. Since the formation of close relationships is further favored by formal and categorical similarities, this mechanism also has a homogenizing effect with respect to them.

4.1.3. Indirect relations and triadic closure

Besides direct relationships, indirect relationships are also relevant for IKSI partner selection. Indirect relationships describe triadic constellations in which two of three individuals have strong ties to each other. In addition to direct relationships, indirect relationships are also relevant for IKSI partner selection. Indirect relationships describe triadic constellations in which two of three individuals have strong ties to each other. If this is the case, an individual A, who is connected to the two otherwise unconnected individuals B and C, can act as a mediator between them. On the one hand, this refers to the attribution of competence. In the context of an IKSI between A and B, who are connected by a strong relationship, A can grasp B's knowledge needs and, to his knowledge of C's knowledge, refer B to him as an IKSI partner. Due to the strong relationship that A maintains with both of them, his recommendation appears to be reliable and is likely to be complied upon.

In addition, A has a trust-building effect for two reasons. First, a trusting relationship between A and C can be interpreted by B as a sign of the latter's trustworthiness.

“Better than the statement that someone is known to be reliable is information from a trusted

informant that he has dealt with that individual and found him so.” [68]

On the other hand, A serves as a control instance. Since A has referred B to C, A’s reputation is also at stake to a certain extent. If C behaves opportunistically in the context of the IKSI instigated by A, and B suffers in consequence, A is attributed a partial responsibility therefor by B. Accordingly, the relationship between A and C would be impaired. Thus, there are additional incentives to behave non-opportunistically and, reflecting that, trust is greater [56, 69].

Typically, personal networks in organizations are more complex than triads. However, the simple example is well suited to illustrate the effect of indirect relationships. Building on this, network research shows that the propensity for triad closure leads to the formation of cliques. These findings suggest that when third-party mediation extends beyond an individual’s closer personal network, partners are still likely to be nearby in social structure and are therefore unlikely to bridge holes in social structure. Since the formation of strong ties is also structured by who formally has more to do with whom, the social structures correlate with the formal structures. Accordingly, third party mediation also tends not to lead to formal boundary spanning. Engaging mediating third parties in the partner selection decision thus contributes to the local search for IKSI partners in terms of both social and formal structure.

4.1.4. Space

While the mechanisms discussed so far operate through their influence on partner choice decisions, spatial structures affect both such decisions and the occurrence of interaction opportunities [70]. For decision-based explanations, it is significant that there is a strong preference to conduct IKSI face-to-face. This requires overcoming spatial distances and barriers. Empirical evidence shows that the willingness to visit colleagues decreases rapidly beyond a distance of 20 meters and that obstacles such as stairs or doors further reduce the probability for interaction [20, 71, 72]. Spatial distances, in themselves, are only weakly linked to different knowledge sets of individuals. However, since the spatial structures of organizations are usually strongly aligned with formal structures, and colleagues who work closely together also sit together, and boundaries between organizational units are often materialized by spatial boundaries such as roads, staircases, walls, and doors, spatial distances and barriers also induce peo-

ple to search locally and to choose IKSI partners that are closer in terms of formal structure.

4.2. Opportunity-based explanations of IKSI

Opportunity-based explanations of IKSI differ fundamentally from choice-based explanations of IKSI because they do not focus on the cognitive processes underlying the partner choice, but on the tangible conditions of the practical formation of IKSI. Although this approach seems to be very promising and some important insights have been gained in recent years, the research field is still clearly dominated by choice-based research [8, 73]. The depth and breadth of opportunity-based explanations is therefore not yet at the same level. Nevertheless, a solid groundwork has been laid, which allows for a comparative analysis with regard to the research question focused on here.

Spatial structures are also the starting point for explaining the unplanned occurrence of IKSI. Research in this area shows that individuals in organizations maintain relatively stable patterns of everyday movement, which result primarily from the arrangement of locations that are relevant to their daily lives, such as entrances, offices, laboratories, coffee kitchens, and canteens. Based on this, unplanned encounters can be approximately explained [48, 73–75]. Further research has shown that specific encounter settings prompt individuals to interact and realize spontaneous IKSI [76–78]. For example, colleagues who are durably copresent and at the same time approachable due to the low level of activity during copying are very likely to interact, even if they know each other only superficially. If the situation further offers a corresponding reason for conversation and grants the possibility to control who is listening in, IKSI among colleagues are very likely. Insofar such situations suggest appropriate interactions, the partner choice decisions described in the preceding are significantly weakened. Because IKSI arise from the situation, developers seeking advice do not express the need for help that might be expressed if they deliberately asked colleagues for advice. Therefore, less trust is required. Moreover, in the specific situation, individuals have less time to consider the suitability of the interlocutor in a discriminating way and, since the interaction is already in progress, are rather willing to listen to the advice even if they have no reason to expect helpful input. Under these circumstances, such attributions play a role only in extreme cases, such as when particular distrust seems indicated. Unplanned encounters under favor-

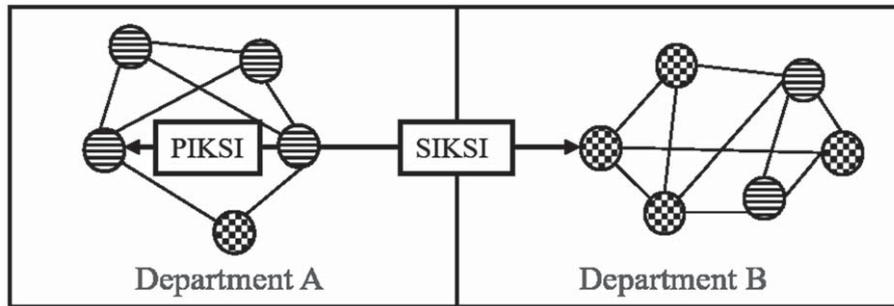


Fig. 1. PIKSI typically connect individuals that are categorically, formally and socially similar (local search) while SIKSI connect individuals that are different in this respect (boundary spanning).

able conditions thus lead to interactions and IKSI relatively independently of the qualities attributed to a person. Because unplanned encounters are less constrained by the spatial location of the immediate workstation but are more widely dispersed, they are also largely decoupled from formal and social structures. They thus bear the potential to generate IKSI between colleagues who are categorically, socially, and formally distant from each other.

Crucial in determining the extent to which this potential is realized is who is likely to encounter each other unplanned and under favorable situational conditions. Key to this are the specific spatial structures of the work environment. Organizations that are spatially fragmented to such an extent that there are no common entrances and no common canteens prevent employees who are structurally distant from encountering each other accidentally. However, empirical studies show that there is usually quite a substantial overlap between the movement profiles of individuals from different departments [73, 75]. IKSI that arise from unplanned encounters are accordingly not completely independent of categorical, social-structural, and formal-structural proximity of the interaction partners, because these are expressed to some extent in the spatial structures and partner choice decisions are also effective to a very attenuated level in the context of spontaneous interactions. However, they are thus decoupled from them to a fairly large extent.

4.3. Summary

In this section, I have presented the mechanisms that explain the formation of IKSI and asked in each case to what extent they bring together heterogeneous interaction partners in terms of social categorization, social structure, and/or formal structure. I posed the question in light of the finding that heteroge-

neous interaction partner constellations have proven to be particularly fruitful for innovation projects, as they are more likely to provide non-redundant knowledge and open up new perspectives. The analysis has shown that all mechanisms that affect partner selection decisions and thus explain PIKSI constitute local search and thus lead to the involvement of a few homogeneous colleagues. In contrast, opportunity-based explanations are particularly powerful in the formation of SIKSI. Accordingly, the logic underlying their emergence appears to be highly decoupled from categorical, social-structural, and formal-structural constraints (see Fig. 1).

SIKSI therefore promise more heterogeneous interaction partner constellations that are more likely to provide new perspectives and thus important impulses for innovation projects. In the following, this argument will be tested in a first empirical investigation.

5. Method

The derived argument claims that SIKSI are more likely than PIKSI to open up new perspectives. The link between the formation and impact of IKSI has not yet been adequately considered. One reason for this is that it is a particular challenge to validly capture the formation of interactions. Accordingly, the study presented in the following aims not only to empirically test the theoretically substantiated link, but also to propose and exemplarily apply an adequate procedure for validly detecting the formation of IKSI.

5.1. Case selection

The participants recruited for the study are the heads of innovation projects located in the central

development department of innovative companies in knowledge-intensive industries and therefore typical of research on IKSI. IKSI play an important role in the everyday lives of these individuals. Although they are highly qualified, their projects repeatedly take them to the limits of their knowledge, which means that they face a high need for IKSI providing efficiently relevant and non-redundant knowledge [20]. Therefore, it seemed likely to me that the formation and impact of IKSI could be well studied here.

Further, the number and range of observable IKSI depends on the opportunities to conduct such [9, 73]. Due to confidentiality agreements, developers are incentivized to primarily find IKSI partners within their own organizations. Therefore, companies with large numbers of employees in research and development and related fields were selected. In selecting the department, I also ensured that it was located in a central site so that various opportunities for SIKSI would arise in everyday life. Within these requirements, a list of 31 companies was compiled whose research centers were within acceptable proximity to my location. The final factor in selecting among these was the willingness of those responsible in the organizations. In order to keep the effort associated with data collection within manageable limits, and to ensure greater comparability between cases, all project managers from the R&D department were included in each case. The sample consists of 41 developers, distributed among three corporate research & development departments of large companies located in Germany and Switzerland and which are primarily active in the fields of material science and electrical engineering.

5.2. Data collection

The particular challenge of the empirical study was to validly record the occurrence of the IKSI. The two

procedures established in the research field appeared unsuitable for this purpose. In the network-analytical studies on IKSI, it is typically asked retrospectively with which colleagues such interactions took place. However, critical studies of this procedure have demonstrated recall biases [79, 80]. In particular, it has been shown that participants are worse at recalling interactions that tend to be less common. This may be tolerable for many studies. Here, however, it would mean that especially SIKSI would not be adequately represented. A comparison would therefore lack robustness.

More robust methods are used by some studies that focus on the spatial embeddedness of the formation of interactions [e.g. 76, 81]. In these, the interactions themselves are captured through observations. However, this approach also seems unsuitable here, since these studies only insufficiently succeed in differentiating forms of interaction. Based on the observation of an interaction, it is only possible to a very limited extent to determine whether it is an IKSI and whether it is planned or serendipitous. The information that is crucial for the question focused on here could therefore not be reliably recorded in this way.

We therefore decided to use event-based diaries [82]. This method is characterized by participants themselves recording events according to predefined rules. Namely, the participants were instructed to document interactions whenever they discussed topics related to current development projects with people formally not involved in them. To structure the documentation, participants were supplied with a digital diary template. To determine whether the recorded interaction was a SIKSI or a PIKSI, participants were asked how the interaction occurred (see Fig. 2).

If the fourth box was checked, the interaction was classified as SIKSI. If the third box was checked, further consideration was given to how spontaneously the intention evolved. If the question about

How did the interaction come about? (single selection)

- We made an appointment to talk about this issue.
- I just called the person/went to the person and approached her/him.
- We had an appointment with another goal and turned to this issue.
- We met accidentally and the discussion about that issue arose spontaneously.

Supplements:

Fig. 2. Question on the formation of IKSI from the diary template.

How did you come up with the idea that the person you talked to could be an appropriate contact? (multiple selection)

- My personal experience with the person caused it.
- Existing knowledge about the person beyond personal experience caused it.

That was caused by information I gathered by...

- ... asking people in my environment.
- ... scanning documents and databases with that goal.

That was caused by information I gathered rather accidentally by ...

- ... chatting with somebody else.
- ... participating in a meeting or event without that goal.
- ... reading a document without that goal.

Only during the encounter with the person I realized, that ...

- ... the person has the competence I was looking for.
- ... the known competence of the person could be valuable.
- ... the competence of the person which I did not suspect and did not look for, could be valuable.

Supplements:

Fig. 3. Question on the intentionality of IKSI from the diary template.

this (Fig. 3) was answered with “Only during the encounter...”, the interaction was also classified as SIKSI.

Finally, it was asked whether the interaction had opened up new perspectives on the project. As an additional quality control, interviews were conducted with all participants to reconstruct how the interactions occurred and to verify whether they were indeed SIKSI or PIKSI. IKSI were recorded in this way for one month in each of the three departments. Data collection was conducted in all cases in 2017 and a total of 132 IKSI were recorded.

The data basis allows a first empirical test of the conceptually elaborated correlation. However, it is limited in two respects. First, the number of cases is comparatively small. Second, new perspectives are recorded and interpreted here as an indicator of heterogeneous partner constellations, while the heterogeneity of the partners themselves is not captured independently.

5.3. Data analysis

To test the assumption about the relationship between the formation and impact of IKSI, the data

on impact were cross-tabulated using the described classification of interactions in SIKSI and PIKSI. Significance was then tested using the two-sided chi-square test. This test tells whether the observed frequencies of one group are significantly different from those of another group or from an expected value. Here, the frequency of new perspectives in the SIKSI and PIKSI groups was compared.

6. Results

The count of the 132 cases initially shows that 65 cases are SIKSI and the remaining 67 cases are PIKSI, so that the two types of IKSI are statistically well comparable. Counting the frequencies concerning the outcomes of the IKSI reveals a clear picture (Table 1). While 75% of the SIKSI open up new perspectives, only 43% of the PIKSI do so.

Table 1
Frequency of interaction outcome “new perspective” by type of interaction

	SIKSI	PIKSI
New perspective	49 (75%)	29 (43%)
No new perspective	16 (25%)	38 (57%)

The two-sided chi-square test shows that the differences found here between SIKSI and PIKSI are not random and thus significant (significance level 0.01). Hence, the analysis shows that SIKSI significantly more often lead to new perspectives than PIKSI.

7. Discussion and conclusion

Informal knowledge sharing is of fundamental importance for numerous knowledge-intensive processes in organizations and especially innovation projects. Research on the effect of such interactions in organizations has shown that particularly heterogeneous partner constellations open up new perspectives that give important impetus to innovation projects. By facilitating the success of the projects, such IKSI enhance job satisfaction and well-being of employees. However, research also shows that, contrary to this evidence, IKSI in practice primarily connect individuals who are categorically, socio-structurally, and formal structurally proximate to each other. There is a bias toward local search. Against this background, the question arises as to how IKSI between heterogeneous partners nevertheless emerge.

The main contribution of this paper is to provide an elaborate answer to this question. Following the literature on serendipity, I have argued that serendipitous informal knowledge sharing interactions are more likely than planned informal knowledge sharing interactions to connect heterogeneous partners and lead to new perspectives. To substantiate this argument, I intertwined the two unconnected strands of literature on the formation and impact of informal knowledge sharing interactions. Drawing on this rich knowledge base, I elaborated the different mechanisms by which SIKSI and PIKSI are formed and which categorical, social, and formal partner constellations form in consequence. Hence, I showed in detail why SIKSI are more likely to provide valuable impetus for innovation projects. Complementing this, the argument that SIKSI more often lead to new perspectives than PIKSI has been confirmed in a first empirical investigation. The paper thus offers a solidly substantiated argument that is relevant in the three referred research fields and in practice.

A starting point for further research results from the limitation of the presented empirical study. Due to the high plausibility, the heterogeneity of the interaction partners themselves was not recorded.

However, it seems possible that the higher fertility of SIKSI has other causes besides partner heterogeneity. For example, it seems plausible that the interaction situations in which SIKSI typically take place encourages more open-ended interactional behavior because interactions in such situations are less focused on specific questions and the mutual expectations are less elaborated and constraining [77, 78]. A closer look at the causes of the correlation therefore seems worthwhile.

The basic argument was derived from the research on serendipity [10, 81]. In this literature, it is emphasized that serendipitous events can provide important impulses for innovations in research and development. So far, however, only anecdotal references to serendipitous interactions have been made. This paper has systematically considered such interactions and reconstructed them in detail on the basis of the related literature. Thus, an important subject of this emerging field of research has been profoundly explored. A special feature is that not only a single serendipitous phenomenon was considered, but it was systematically compared with the planned counterpart. The comparative analysis enabled to precisely determine the significance of serendipity for the specific case of IKSI. In light of the findings, it seems extremely promising to pay further attention to serendipity phenomena, systematize it more strongly and to compare the underlying processes with planned processes.

Concerning research on the formation of interactions and the relations that emerge from them, the findings of the paper primarily call for a further distinguishing of partner constellations [8, 9]. Typically, in this research, the formation mechanisms are brought into focus, while the categories for interactions and relationships remain fuzzy. Here, the distinction between heterogeneous and homogeneous interaction partner constellations, which is found to be extremely important from research around the effect of interactions, was introduced and revealed that they follow different formation logics. This analytical distinction significantly extended the explanatory power of the known mechanisms. For further research, it seems extremely promising to leverage even more potential by distinguishing more precisely between partner constellations or types of interaction in explaining their formation. This promises a more accurate description of the underlying formation mechanisms. Further, comparative analysis of specific interaction types and their formation promises generalizable insights on this

connection. These could be the basis of a general theory on which characteristics of interactions are associated with which formation mechanisms. Since interactions and relationships are of fundamental importance in numerous fields, such a theory would have a significant impact.

With regard to research on the effect of interaction partner constellations [45], this paper expands the focus to their formation. Although this research deals with dynamic processes, interactions are often conceptualized as static channels and reduced to the characteristics of the individuals involved. Although this conception of the object was adopted here and the explanation of heterogeneous and homogeneous partner constellations was explored, with their formation at least a part of the phenomenon was considered in its dynamics. This has proved to be extremely fruitful here. Subsequently, it seems promising to consider further parts of interactions as a process. Specifically, we should ask about the scope of action individuals have in the respective constellations, how varying agency can be explained, and what consequences they have respectively. A seminal example is the contribution of Obstfeld et al. [83], who show that individuals in broker positions can act differently and that the structural constellation has different effects depending on their behavior. However, further research is needed, for example, on which practices make the same heterogeneous partner constellations result in innovations or in conflicts.

Finally, the paper underlines the importance of informal and unplanned interactions in the context of innovation projects and other knowledge-intensive activities in organizations. This point seems to be particularly important against the backdrop of digitization - which has been significantly accelerated by the corona crisis. Digitization is often accompanied by a strong formalization of processes. In consequence, the opportunities for informal and unplanned interactions, are increasingly disappearing. The paper can therefore also be read as a call for a stronger consideration of informal and unplanned interactions when organizing work and designing (especially technical and spatial) working environments. Indications for appropriate design measures are provided by studies that reveal the general situational prerequisites for such interactions [77, 78] as well as those that focus on the effect of specific medial or spatial work environments on interactions [84, 85]. However, further research is needed here to provide a reliable basis for the careful design of such measures.

Ethical approval

Not applicable.

Informed consent

Not applicable.

Conflict of interest

None to report.

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