Progress and Stewardship in Information Systems Research: Addressing Barriers to Cumulation through Active Process Ownership

Full Paper

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Abstract

Scientific cumulation is regarded as the goal of the information systems field but is challenged by complex and unaligned incentives operating differently at both institutional and individual level. Few studies have explored how incentives create barriers to scientific cumulation and how these can be addressed to achieve improved scientific progress. To address this, we introduce a process model of scientific cumulation and combine this with the perspective of business process management to describe the scientific process that must be managed and to show how active process ownership can contribute to stewardship of the scientific process. We argue that unaligned incentives that influence the IS field can best be managed with the goal of scientific progress and cumulation in mind, where process owners at many levels actively address barriers to cumulation.

Keywords

Information systems research, cumulation, cumulative tradition, process perspective, epistemology.

Introduction

Macro-political incentives such as funding based on scientometrics and micro-political incentives such as career promotion based on publications influence information systems research (Chiasson 2014). These complex multi-dimensional incentive systems are not necessarily designed with the same goals in mind. Analyzing the consequences of these incentive systems is a difficult task. We argue that incentives influence the increase and advancement of scientific knowledge in the IS field and produce barriers that stagnate cumulation or can lead cumulation to take place in suboptimized research silos. Thus, various stakeholders within the IS field need to be aware of these barriers and seek to address them to improve cumulation. Cumulation describes the ability to develop knowledge where "researchers build on each other's and their own previous work" (Keen 1980, p. 13).

The discussions on the legitimacy and status of the IS field have been subject to much attention from IS researchers since Keen (1980) addressed the problematic status of IS research almost 40 years ago. Historically, the introspective IS debates have taken several directions. Either in succession or simultaneously, discussions have focused on cumulation, the relationship of IS with its reference disciplines, rigor and relevance, the field's identity, legitimacy and core, and the importance of the IT artifact (see Hassan (2014b) for an overview). All these issues are related since they address various aspects of scientific progress and the value of our research to society. Cumulation is salient because the importance of a research paper lies not within itself but through seeing it in combination with other studies: "A particular department or university may produce a set of papers that individually don't say much but when combined with work from others around the world may represent important components in larger work" (Niederman 2014, p. 834). The value of IS research increases if we improve our ability as a field to "assemble knowledge and value across individual studies and topics" (Niederman 2014, p. 834).

Two different meanings of cumulation have occurred in science where one sees cumulation as the increase in the aggregated scientific knowledge, whereas the second meaning sees cumulation as the increase in volume by the number of published articles and analyzed problems. We see examples of this duality in the recent debate in the IS field where Cuellar et al. (2016) illustrated the broader meaning of cumulation in the concept of 'ideational influence' and the second meaning in their suggested publication metrics as a partial measure of the cumulative volume of 'scholarly capital' to improve scientific output. The problem with various metrics as science indicators is that they fail to take into account the semantic content of publications. Thus, the value of a publication can only be assessed based on its contribution to the extant knowledge at that time (Niiniluoto 2015).

The purpose of this paper is twofold: First, we raise awareness of how external and internal incentives influence scientific progress by creating barriers to cumulation. Second, to address these barriers we adopt a process perspective and suggest active process ownership as a mean to increase cumulation.

Perspectives on Scientific Cumulation

Scientific cumulation is concerned with the increase and advancement of scientific knowledge which are the cognitive aspects of scientific progress. There are numerous perspectives on scientific cumulation from which some are more well-known and dominating: the principle of falsification by Karl Popper and the shifts of paradigms by Thomas Kuhn. While Popper addresses evolutionary cumulation, Kuhn addresses revolutionary cumulation.

Karl Popper and the Principle of Falsification: Evolutionary Cumulation

Karl Popper rejected empiricism, the classical view of science which states that knowledge can be derived only from empirical evidence (Popper 1959), i.e., some kind of data obtained by the means of the senses. Empiricism is tightly linked with inductivism attributed to Francis Bacon, which is the traditional scientific method for treating empirical evidence. The method is characterized by observing patterns in nature and suggesting laws that can be tested and confirmed through many additional observations. The laws are tuned in accordance with observations while rejecting disconfirmed test results.

Popper termed his philosophy 'critical rationalism' introducing falsification (Popper 1959). He criticized the idea of drawing universal conclusions from empirical data and called this practice 'the problem of induction' meaning that findings could not be confirmed by observations. He argued that the whole idea of verification should be abandoned. The notion of a 'scientific truth' had to be rejected as scientific knowledge is tentative. Instead, Popper (1959) introduced the concept of falsification: a hypothesis can never be verified; only falsified from being scrutinized and proven incorrect and then rejected. Thus, he focuses on revealing untrue statements as opposed to discovering true statements. He related falsification to the very foundations of scientific inquiries; only claims that could be falsified are considered scientific. Similar to the Occam's razor principle (law of parsimony), Popper (1959) held that the simplest of theories should be preferred over complex theories since they are more easily testable.

Thomas Kuhn and Paradigm Shifts: Revolutionary Cumulation

Kuhn (2012) argued that scientific revolutions ("paradigm shifts") are necessary for science to progress, and disputed the traditional view of science as a linear accumulation of knowledge. Scientific inquiries can be divided into three distinct stages: prescience, normal science, and revolutionary science. In prescience, there is no central dominating paradigm thus causing all facts related to a certain phenomenon or science to be equally relevant. The scientific debates will after a while encourage more precise and detailed work because researchers get convinced that they are embarking on a journey that accepts the solutions for existing problems. Normal science describes scientific work within a central and dominating paradigm.

Researchers dedicate themselves to the existing paradigm producing research that addresses a whole range of problems and issues. Because the confidence in the existing paradigm is high, contradictory results are often viewed as flaws in the research design and related to reliability and validity issues at the expense of the researcher. In fact, researchers will go a long way to defend the paradigm: "Much of the success of the enterprise derives from the community's willingness to defend [the accuracy of the existing paradigm], if necessary at considerable cost" (Kuhn 2012, p. 5). Instead of falsifying existing studies and ultimately the paradigm, conflicting research pile up and eventually cause a crisis and thus loosen the rules of the normal problem solving practices. A new paradigm sees the light based on the old conflicting studies and is eventually accepted, entering the stage coined revolutionary science.

The different paradigms are incommensurable in that they cannot be combined or understood through the conceptual frameworks and terminology of each other. Once a paradigm is established, the previous paradigm is rendered incorrect and useless, and cannot explain the phenomena at focus. The transition from a paradigm to another where a new tradition of normal science can emerge is to Kuhn "far from a cumulative process, one achieved by an articulation or extension of the old paradigm. Rather it is a reconstruction of the field from new fundamentals [..]" (Kuhn 2012, p. 85). While Kuhn is negative to cumulation, we argue that evolutionary changes from replications and testing with empirical data, will reveal the soundness of a theoretical model and reveal the need for radical redesign and paradigm shifts. Stimulating cumulation is important as it will challenge poor theoretical models that lack support.

Cumulation of Scientific Knowledge as a Holistic Cyclical Process

Cumulation of scientific knowledge can be seen as a cyclical process; an idea first developed by Wallace (1971). His "schematic" framework of cumulation has not to our knowledge been used to study cumulation in the IS field. By using this framework, we acknowledge theory advancement as an indicator of a cumulative research tradition similar to other authors (e.g., Weber (1999) and Larsen and Levine (2005)) who analyzed the state of cumulation in the IS field. Wallace (1971) argued that the logic of induction and deduction could be combined in an ongoing cycle with alternation between theory building (or refining) and theory testing that results in a holistic view of scientific cumulation. By decomposing the principal components of the scientific progress; the framework illustrates the process of justifying scientific claims. Wallace (1971) barely discusses barriers to cumulation in his book. The framework is used as an instrument for understanding cumulation of knowledge as a process and to illustrate how barriers to cumulation occur. Figure 1 depicts the framework.

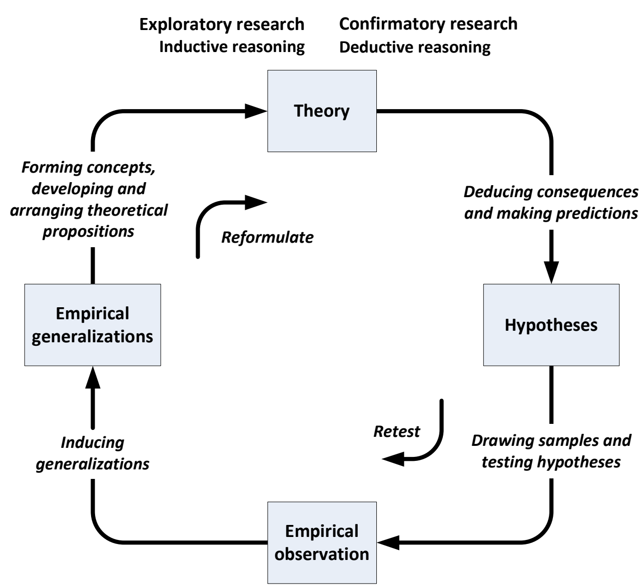

Figure 1. The wheel of science. Adapted from Wallace (1971).

According to Keen (1980), our goal as researchers in the IS field is to develop knowledge by "standing on each other's shoulders" in a cumulative process where we either build on each other's work by testing proposed or existing theory, or criticize, redesign or extend theoretical ideas. Over time, the result can be observed as a maturation process of theoretical prototyping through inductive as well as deductive stages from the proposition of new theoretical ideas to empirical testing and refinements of theory through new propositions. The cumulative process results in increased rigor and relevance, most often through evolutionary steps resembling the principle of falsification by Popper (1959) and what Kuhn (2012) labels normal science. Over time, cumulation might also create a growing awareness in the scientific community that the support for a theory is lacking or too weak. This might stimulate not only the development of revolutionary new ideas that radically redesigns existing theory but also bold guesses leading to what Kuhn (2012) calls paradigm shifts. As a result, improving the process of cumulation might not only stimulate rigor and relevance of theorizing through evolutionary development but also through stimulating revolutionary new ideas.

The State of Cumulation in the IS Field

Research analyzing cumulation in the IS field has come to different conclusions. In his seminal paper, Keen (1980) argues that IS is not a coherent field and in desperate need of a cumulative tradition. Other authors arrive at similar conclusions stating that a cumulative research tradition in the field is absent, elusive, or unclear (Andoh-Baidoo et al. 2004; Benbasat and Weber 1996; Farhoomand 1987; Hamilton and Ives 1982; Larsen and Levine 2005; Teng and Galletta 1991; Vessey and V Ramesh 2002; Weber 1999). These claims are based on various analysis techniques. For example, Hamilton and Ives (1982) use a citation analysis to assess impact from MIS research and come to a discouraging conclusion. Farhoomand (1987) claims that IS lacks its own theories and is not well connected to other reference disciplines. Benbasat and Weber (1996) argue that IS is lacking a core and is more "pluralistic and accommodating of diverse research problems, research methods, theoretical foundations, and paradigms" (p. 391). While these studies identify little if any evidence of a cumulative research tradition, other studies conclude that the field is indeed progressing and that a cumulative research tradition is emerging (Alavi et al. 1989; Baskerville and Myers 2002; Cheon et al. 1992; Culnan 1987; Culnan and Swanson 1986; Farhoomand and Drury 2001; Grover 2012; Robey 1996). While Farhoomand and Drury (2001) base their conclusion on theoretical advancement in the field, Baskerville and Myers (2002) argue that improvements have been made related to IS subject matter, a distinctive research perspective, and an excellent scholarly communication system. While many of the introspective debates have nurtured anxiety discourses (Hassan 2014b), we agree with Grover (2014) that the field shows progress in many aspects such as rigor, relevance, and institutional robustness, but that we can do better.

Political governance of the sector together with IS community practices influence cumulation in the IS field. Governments increasingly express desires to control aspects of scientific work such as standardizations of PhD educations, topics to be studied, and the volume and value of research publications (Hassan 2014a). Studies show that various types of metrics have increased research publication (see e.g., Boer et al. (2015)). There seems to be an implicit assumption that metrics also stimulate cumulation, however to achieve the goals that are defined for each researcher, researchers do more of what they know well. Instead of exploring other research traditions and research methods, they stick to what they are educated within and what they have experience with. Such practice contributes to research "silos" (Balaram 2012) as illustrated in Figure 2. The result of silos is a division of the cumulation process into subprocesses where knowledge is developed and assessed within a research tradition.

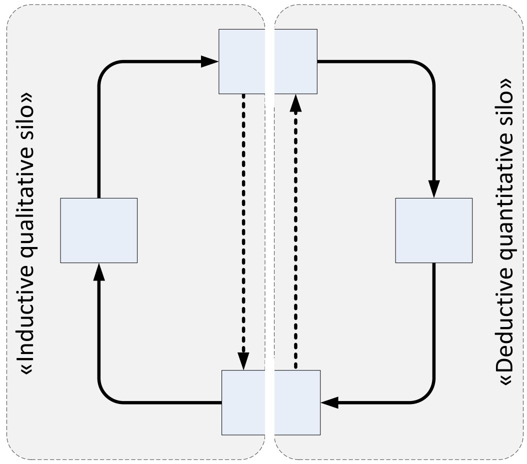

Figure 2. "Silos" with suboptimal cumulation processes.

Few papers have discussed how cumulation can be improved in the IS field. Grover (2014) focuses on how we can use widely accepted conceptualizations that are proven robust to build on each other's work instead of introducing new and incompatible models. Chiasson (2014) follows the ideas of Introna (2003) and calls for a micro-political analysis of the IS field and its practices so that we might stimulate outcomes that are more valuated by our stakeholders. Chiasson (2014) continues with discussing how micro-politics in our field might in fact hinder cumulative work through incentives and structures. If this is true, he argues, we should focus on why researchers are not doing what stimulates cumulative research, i.e., identify barriers to cumulation and address them.

The Process Management Perspective and Stewardship of Cumulation

The functional way of organizing is found to stimulate suboptimization within functional units or "silos", and reduces the ability to manage value creation within the process as a whole. Typically, no person is responsible for the whole process but rather for each functional unit. Business process management (BPM) is a relatively new management concept that addresses such issues under the idea that any process needs to be managed to function properly (Vom Brocke and Rosemann 2010). It is viewed as important to assign different process roles with specific responsibility in setting goals for process performance, monitor performance, and take action if performance is below standard or the process fails to meet its goals. Processes must also be adjusted to changing requirements and potentials defined by the environment (Iden 2009). The process owner is the most important role in process management with responsibility for ongoing process management and continuous process improvements, often with the legitimacy given by a steering committee that oversees strategic goals, organize process management, and allocate resources. Iden (2009) defines the following capabilities as critical for a process owner: engagement and commitment to the process, ability to take action, and knowledge in process thinking.

Applied to the research process in the IS field, the overall process goal is cumulation of scientific knowledge. The overall responsibility for the cumulation process as a whole is held by many different roles acting as process owners and steering committees at different levels. At the lowest level the individual researcher is responsible for his or her own research. Within a research group or department, group leaders, coordinators and department heads are process owners with the ability to take action to stimulate contribution to the cumulative research. Deans, rectors and boards have similar responsibility as steering committees that oversee that resource allocation and strategies support cumulative research performance. For journal editors, reviewers, and conference organizers process ownership implies that decisions regarding scope, accepted publications, calls for new research and topics for conferences are viewed in light of the overall cumulative needs in the IS field. Of course, these activities are taking place every day in the IS field, but conflicts might arise when incentives are designed with different purposes, for instance if publication metrics gain increased importance for individual careers but are not as important for the research of the department as a whole. We suggest that increased awareness of cumulation and clear understanding of process roles and responsibility will make the IS field better able to address barriers to cumulation and stimulate a culture that supports scientific cumulation.

Incentives Creating Barriers to Cumulation

Goals and incentives at the macro-political level can be in conflict with micro-level goals and incentives and result in barriers that hinder or limit scientific work from contributing to scientific cumulation in the field. Barriers can emerge as the result of funding and publication incentives from policies enforced upon the IS community by external stakeholders. Other barriers might occur from journal policies and are results of deliberate choices made by the community itself. Cumulation barriers may cause the cumulation process to stagnate or to take place within limited fields or silos where scientific cumulation is a goal within a limited field. As in process management, silos represent a limited perspective that might be suboptimal to the broader needs of the whole process and often self-reinforcing by producing internal reward systems that contribute to uphold the silos (Wood and Bandura 1989). For example, a PhD student that is specialized within one methodological tradition will likely continue the academic career within the same tradition, especially if publication incentives are demanding and central for further academic career. Time consuming research that spans methods and traditions would be counter-productive for the publication requirements regardless of the broader needs of the scientific field. Other process owners and steering committees will have to address such cumulation barriers by initiating local arrangements or by initiating a debate targeting the cause for suboptimization. In the process management perspective suboptimization would be the case if no process owners are taking active responsibility for the cumulation process in the IS field. We argue that several stakeholders within the IS field; funders, journal editors and reviewers, conference organizers, department heads, PhD programme directors, PhD committees, and individual researchers should take the role as process owners and be aware of barriers to cumulation as illustrated here by examples.

Barriers Created by Specialization and Uniformity

Across various IS communities, divides can be observed related to the use of research methods and theories. For example, in the US deductive research methods are more common than in Europe where inductive work dominates (Chen and Hirschheim 2004). Such traditions might frame PhD programs and the education of future IS scholars. Macro-political goals of internationalization, mobility of researchers and productivity have led to a joint focus on improving and standardizing PhD programs in Europe (Gaebel et al. 2008). A mixture of structural arrangements and financial incentives has been issued to support these goals. Economic incentives and bonuses are used to stimulate departments for every student that finishes on time. Internationalization and mobility of students and staff have been met with structural reforms to allow research, programs and providers to move across borders. The effects of these efforts are standardized and streamlined PhD programs in most European countries, e.g. only method courses deemed relevant for the research project are included. Increased uniformity from specialization in theories and research methods might come at the expense of the capability to do research that is different but that fits better with the needs of scientific cumulation (see Rider et al. (2012) for an overview).

The importance of publications in competing for PhD positions, fulfilling PhD program requirements, and getting tenured is increasing. The supervisor is equally important in the PhD programs than before these reforms (Gaebel et al. 2008), and strong specialization within the supervisor's preferred theories and research methods will ease communication and the likelihood that the candidate produces the required number of research articles. Strong publication incentives could create a focus on quantity and productivity rather than quality and relevance in a broader perspective of cumulation, and over time create a lock-in effect into homogenous research cultures resembling functional silos. Incentives decoupled from an understanding of scientific cumulation process and process ownership can create barriers to cumulation and lead to conformity within departments, research groups and in research topics, methods, and publication channels.

Barriers to cumulation can be reduced by targeted measures from departments and research groups. The EU Commission is aware of the danger of lack of cross-breeding between research departments, and has initiated programs for increased mobility of researchers. Departments should be aware of the same effects and discuss measures at the local level including avoiding employing one's own PhD candidates, increase pluralism in method courses with for example a focus on mixed methods, stimulate method training of the staff, or stimulate cooperation between researchers with different specialization that can brake methodological lock-in effects and conformity. It is also possible for research departments to consider its position in the cumulation model and consider to what extent there is a tendency to produce only one type of article, for example inductive case studies or theory testing work, without following this work further into the cumulation process. To stimulate cumulation, a research department could consider how it can make it easier for researchers outside of the department to use its conceptual work in their theory testing. Such use in theory testing could be made easier if the conceptual researchers included better descriptions of how to operationalize and measure new conceptual content, thus improving content validity (Straub et al. 2004) in theory testing. This would not only improve the academic footprint outside one's own research community, but stimulate cumulation in the IS field.

Barriers Created by Funding

Governments around the world are using bilateral contracts and performance agreements to influence the productivity in higher education institutions through funding (Boer et al. 2015). The rationale behind these incentives is the massive investments in research, and the political wish and demand for pay-off to society. The aim is to increase publication quantity, stimulate research on specific topics important for society, and increase rates of completion, retention and graduation. Different types of metrics are used including bibliometrics, number of students (including PhD students) and exams passed, amount of external funding, etc. (see Boer et al. (2015) for an overview). The influence of these regimes on funding varies from around 25% in Germany and the Netherlands, around 60% i Denmark, and up to almost 100% in Austria (Boer et al. 2015). In the US, around thirty states have implemented similar arrangements influencing from 5-25% of the budgets, but with less focus on research performance compared to Europe (Dougherty et al. 2014). A recent review of studies of the impacts of these programs shows mixed effects as well as many side effects (Kivistö and Kohtamäki 2015). In some countries (e.g. Denmark and Norway), incentives have increased scientific publication (Boer et al. 2015) but in the IS field as a whole, Powell and Woerndl (2008) argue that the increased importance of bibliometrics for institutional funding and individual academic careers have made research in niche fields less interesting simply because it is less cited.

Funding based on publication and citation metrics can take the focus away from the long term goal of research which is cumulating knowledge and advancing the truth. Increasing the number of publications could be important for understanding more about information systems phenomena. However, if the focus of publications are elusive (e.g., focusing on new and exciting topics), they will not advance knowledge on previously studied phenomena. In fact, "there is little reward for advancing what someone else has created. There is much reward for creating something new, even if it is inherently difficult or impossible to advance" (Larsen and Levine 2005, p. 372).

The need for news can create barriers to cumulative knowledge production. Developing strong theories that can explain and/or predict complex sociotechnical phenomena require exploratory work, theory testing, theory refinement, and/or replication studies. In other words, we do not necessarily have to work more, but we have to work better. Since the latter is far more difficult to measure, incentives are often focused on easily measurable indicators. The field of psychology provides an example. It appears that practitioners have less confidence in psychological science due to a series of unfortunate events incorrectly claiming evidence of extrasensory perception (Bem 2011; Pashler and Wagenmakers 2012). Discussions following these events showed that psychological scientists did not make research data available for replication studies and thus reduced the ability to build robust theory and avoid public embarrassment.

Increased competition and scarce resources have made researchers use more time to apply for financial funding (Auranen and Nieminen 2010). Politically defined societal needs for research followed by competitive funding, can take attention away from scientific cumulation especially if the ability to maintain research activities is dependent on the ability to compete for such funding.

Barriers Resulting from Publication Incentives

The huge increase in scientific publication (8-9% annually) is a challenge for the cumulation of scientific knowledge because it increases the complexity of literature reviews that sums up the scientific status and direct further research. The journals and the journal editors have a special role as process owners to direct the increasing stream of publications so that integration and cumulation can take place in the scientific process. Unfortunately, there are examples of journals expressing that they do not take responsibility for stimulating the cumulation process ("we only publish new ideas", or "we only publish qualitative studies" or "we only publish theory testing work"). Others might not follow their own policy of publishing replications (van Witteloostuijn 2015). As important process owners in the scientific cumulation process, editorial boards, journal editors and reviewers should have the process of cumulation in mind and direct the stream of publications towards better theorizing. When a phenomenon has attracted many inductive case studies, editors should ask for reviews and meta studies summing up their communalities. Then, when conceptual models are identified, theory testing studies should be called for, eventually leading to summaries and potential calls for better theorizing if explanatory power is limited. By addressing cumulation, editors and journals will reduce the "divide" between qualitative and quantitative research (Knox 2004) and stimulate integration and scientific growth through better collaboration as a field.

With more theoretical content being suggested, it is necessary to refine these ideas to sort out any 'false positives' in the induction (van Witteloostuijn 2015). False positives are studies with results we believe are representations of the truth while they are not (type 1 error). Later, when new theoretical content is being empirically tested, replications are necessary to remove any 'false positives' in deduction (van Witteloostuijn 2015). When studies are not tested, they cannot be falsified or supported (Ioannidis 2005; van Witteloostuijn 2015). While such replication studies have not been prioritized in many fields (van Witteloostuijn 2015), more focus is now emphasized on such studies. The AMCIS conference has a track for replication studies in 2016 (AMCIS 2016) and the AIS launched the AIS Transactions on Replication Research journal in 2014 (AIS 2016). The goal is not an "endless" replication of the same studies but to ensure the quality of existing knowledge hence facilitating cumulation.

Concluding Remarks

This paper is motivated by the complex system of unaligned incentives that influences research progression in the IS field. One source of incentives is micro-political or internal and created by the internal discussion of the status of the IS field as well as local goals and strategies. The other source of incentives is macro-political or external and manifests itself in performance based research funding systems that have gained increased importance over the recent decades (Hicks 2012). Macro-political incentives allocate funding at the institutional or departmental level with less consideration of consequences at the individual level. The observed conflicts between incentives working at different levels have created considerable public and academic debate (Aagaard 2015).

To discuss how this complex set of unaligned incentives can be constructively managed for scientific progress in the IS field, we introduced a process model of scientific cumulation and combined this with the perspective of business process management. Together, these perspectives help us first to describe the scientific process that must be managed, and then to introduce process ownership to show how active process roles can contribute to stewardship of the process of scientific cumulation. We argue that the set of complex and unaligned incentives that influence the IS field can best be managed with the goal of scientific progress and cumulation in mind where process owners actively address barriers to cumulation. We believe that by combining these perspectives we can increase the awareness in the IS field of not only how unaligned incentives can create barriers to scientific progress and thus need to be reconciled, but also how we as a field could deal with the current situation and contribute to scientific progress.

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