The Basic Concepts Classification (BCC)†

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Abstract: The *Basics Concept Classification* (BCC) is a "universal" scheme: it attempts to encompass all areas of human understanding. Whereas most universal schemes are organized around scholarly disciplines, the BCC is instead organized around phenomena (things), the relationships that exist among phenomena, and the properties that phenomena and relators may possess. This structure allows the BCC to apply facet analysis without requiring the use of "facet indicators." The main motivation for the BCC was a recognition that existing classifications that are organized around disciplines serve interdisciplinary scholarship poorly. Complex concepts that might be understood quite differently across groups and individuals can generally be broken into basic concepts for which there is enough shared understanding for the purposes of classification. Documents, ideas, and objects are classified synthetically by combining entries from the schedules of phenomena, relators, and properties. The inclusion of separate schedules of—generally verb-like—relators is one of the most unusual aspects of the BCC. This (and the schedules of properties that serve as adjectives or adverbs) allows the production of sentence-like subject strings. Documents can then be classified in terms of the main arguments made in the document. BCC provides very precise descriptors of documents by combining phenomena, relators, and properties synthetically. The terminology employed in the BCC reduces terminological ambiguity. The BCC is still being developed and it needs to be fleshed out in certain respects. Yet it also needs to be applied; only in application can the feasibility and desirability of the classification be adequately assessed.

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1.0 Introduction

The *Basics Concept Classification* (BCC) is a "universal" scheme: it attempts to encompass all areas of human understanding. Diverse users—both general users from different cultural backgrounds and scholars from across disciplines—can potentially utilize the BCC to find documents, objects, or ideas produced in any culture or discipline. Whereas most universal schemes are organized around scholarly disciplines, the BCC is instead organized around phenomena (things), the relationships that exist among phenomena, and the properties that phenomena and relators may possess. As we shall see below, this structure allows the BCC to apply facet analysis—an approach to classification long emphasized within the field of knowledge organization—without requiring the use of "facet indicators"[1] to tell the user which facet is being addressed by a particular notation.

1.1 Motivation

The main motivation for the BCC was a recognition that existing classifications that are organized around disciplines serve interdisciplinary scholarship poorly. The fact that different terminology and organizing principles are pursued

for different disciplines hampers the research and communications of interdisciplinary scholars and students. Over time, a variety of other advantages of a classification grounded in phenomena, relationships and properties have been appreciated. Such a classification can achieve greater precision even within disciplines than existing classifications achieve and can be used across galleries, libraries, archives and museums (the so-called GLAM sector) and indeed across any organized repository of information. (We shall see in Section 2.4 below that a classifier employing BCC moves fairly directly from a sentence in an object or document description to a BCC subject string and can, therefore, treat any document or object or idea that can be described in a sentence.) This is especially important as users increasingly seek information across a variety of different databases and, at present, struggle to master different classifications and search interfaces for each. Such a classification is useful not just for documents but for objects (thus its utility for museums and galleries—Szostak 2016, 2017) and ideas (and thus its utility for a variety of databases). It may prove advantageous for the semantic web, since its separate schedules of things, properties, and relators are well-suited to the (subject)(predicate or property)(object) structure employed on the semantic web. (Szostak, Gnoli, and Lopez-Huertas 2016, 177-82).

1.2 History of the BCC

Szostak (2004) speculated on the value for interdisciplinarity of a classification system grounded in phenomena rather than disciplines. That book also reprised a three-page hierarchical table of the main subjects addressed by human scientists. Szostak (2004) was aimed primarily at practicing interdisciplinary scholars. Over the next years, Szostak published a series of articles in the *Journal of Documentation, Journal of the Association for Information Science and Technology (JASIST), Library Trends,* and especially *Knowledge Organization*, which sought to both justify and describe the approach to classification taken in the BCC. At the same time, the BCC was fleshed out to reflect the principles outlined in these various publications. The BCC website[2] discusses how each of about two dozen articles and books supports the project of BCC.

The classification of phenomena expanded on the table developed in Szostak (2004), which itself had reflected the reading of hundreds of works across all human science disciplines in Szostak (2003). Ten main categories of phenomena were identified: 1) two individual-level categories of "genetic predisposition and individual differences" and "non-human environment;" and, 2) seven societal-level categories, "art," "culture," "economy," "health and population," "politics," "social structure," and "technology and science." These were subdivided logically in terms of "type of." Several more categories have been added to address natural science subject matter: in accord with the idea of integrative levels these address "waves and particles," "molecules and atoms," "rocks," "biological entities," "flora and fauna," "celestial objects," and "mathematical concepts." Schedules of relators were added over time, based on Szostak (2012), and these were given quite different notation from the schedules of phenomena. A schedule of "properties" was developed inductively over time as the BCC was used to classify sets of documents and objects; it also is notationally distinct. The notations employed for phenomena, relators, and properties are described in sections 2.1, 2.2, and 2.3 respectively below. We can recognize here that one key goal in assigning notation was to ensure that these three quite different types of schedule were easily distinguished. Other goals were to have very short notations so that multiple terms could be combined in subject strings. Wherever possible, notation was developed that would be easy for users and classifiers to remember.

As Szostak developed the scheme, he was encouraged and informed by preceding efforts to develop a universal phenomenon-based classification within the field of knowledge organization (Szostak, Gnoli, and Lopez-Huertas 2016, 96-100, review this history). The Classification Research Group in the United Kingdom had discussed the principles of such a scheme in much detail over a period of many years (e.g., Classification Research Group 1969). The most important influence, though, has been Claudio Gnoli, who has pioneered the Integrative Levels Classification (ILC; 2004-; Gnoli 2016; 2017a; 2017b; 2018). There are many similarities between the ILC and BCC; both take a faceted phenomenon-based and analytic-synthetic approach to classification. Szostak has contributed to the ILC project, learned much from it, and co-authored several papers and a book (the latter with and inspired by Maria Lopez-Huertas) with Claudio Gnoli. The major initial difference between the BCC and ILC was the development of separate schedules of relators and properties; this has led over time to an emphasis within BCC on the development of subject strings that follow grammatical rules (see below). Gnoli, Szostak, Lopez-Huertas, and others also collaborated on the León Manifesto, issued after the ISKO-Spain conference in León in 2007 to urge an approach to classification more sympathetic to interdisciplinary scholarship. Szostak also benefitted from theoretical discussions with Birger Hjørland and others over the years (see Fox 2012 for a discussion). Szostak and Richard Smiraglia have collaborated in recent years on a series of papers and a research grant that (among other things) compare the BCC to both the Universal Decimal Classification and the Linked Open Data cloud: This research has inspired much further clarification and testing of the BCC (Smiraglia and Szostak 2018, Szostak et al. 2018).

Documents, ideas, and objects are classified synthetically by combining entries from the schedules of phenomena, relators, and properties. It was recognized eventually that the resulting subject strings resembled sentences or sentence fragments. Szostak, in a series of publications (especially 2017), then explored the advantages of pursuing a grammatical approach to classification. The BCC and the rules employed for synthesizing subject strings were adapted to pursue purposely a common grammatical form. One key advantage of doing so is that a user query entered grammatically can be readily translated into an appropriate and relevant subject string.

The BCC has been developed online at: https://sites.google.com/a/ualberta.ca/rick-szostak/research/basic-concepts-classification-web-version-2013/guiding-principles. Many additions have been made to the BCC online since it was uploaded in 2013. The schedules for the subject matter of the human sciences are largely complete (with some exceptions such as the treatment of mental disorders), but work remains to be done on several schedules addressing natural science phenomena. The schedules of relators and properties are well developed. The classification has been successfully employed in classifying dozens of randomly selected documents and museum artifacts. The BCC is being translated into linked open data. Other ongoing developments are discussed toward the end of this article.

1.3 The nature of basic concepts

Scholars of knowledge organization worry about whether different individuals and groups can have the same understanding of terminology. One advantage of a discipline-grounded approach to classification is that scholars within a discipline may have similar understandings of the terminology employed in their discipline. Szostak (2011) argued that complex terms that might be understood differently by different groups or individuals could be broken into basic concepts for which there was a broadly shared understanding across groups and individuals. "Globalization" might be ambiguous but "exports" (of goods) was likely to be understood in a broadly similar way by most individuals. This shared understanding need not be perfect in order for quite different individuals to be guided to relevant documents (or objects or ideas) by the same classification system. Basic concepts are defined then as concepts for which there is enough of a shared understanding for the purposes of classification. The BCC has been constructed wherever possible in terms of basic concepts. It is hoped in future to test the hypothesis that diverse users have broadly similar understandings of BCC terminology. Scope notes could be provided to clarify terminology in cases (such as political ideologies) where it is difficult to reduce ambiguity to the desired level.

Philosophers have long debated the nature of concepts and whether it is possible for diverse individuals to have shared understandings of concepts. Szostak (2011) reviewed leading concept theories and argued that most if not all of these supported the idea of basic concepts. He stressed that philosophers often focused on whether precise definitions of concepts were possible; classificationists can be satisfied with a more relaxed standard: can enough similarity in understanding of a concept be achieved such that users of the classification can be guided to relevant documents, objects, or ideas?

Classificationists debate whether to employ precise jargon in classifications—at the cost of users being unfamiliar with terminology—or instead employ natural language—with the danger of ambiguity. Reliance on basic concepts allows us to have the best of both worlds, for there is considerable shared understanding of the meaning of basic concept terminology as employed in everyday language.

1.4 Guiding principles

We have already mentioned some key guiding principles:

- Synthetic classification utilizing separate schedules of phenomena, relators, and properties
- Short logical hierarchies of phenomena
- Reliance wherever possible on "basic concepts:" those that are understood in broadly similar ways across individuals and communities
- Synthetic subject strings generally resemble sentences or sentence fragments. The use of common grammatical format facilitates search; a user's search query can be translated into the most relevant subject string.

Some other key guiding principles can be mentioned:

- For relators, several dozen key relators are developed within a handful of very flat hierarchies. These can be combined synthetically with each other and with phenomena or properties to generate thousands of very precise relators.
- Hierarchies of phenomena generally reflect a "type of" disaggregation (rarely "elements of"), which reflects an ontological understanding of the world, supplemented as necessary by literary warrant, ensuring that all relevant concepts are captured.
- The notations attached to concepts are generally both short and expressive. It is thus possible to synthesize several terms and still have a notation for a subject string of manageable length. A user familiar with the classification may be able to recognize the string from the notation.
- Detailed classifications of methods and theory types are included in the classification of things so that works can be precisely classified in terms of the theories and meth-

ods applied as well. Scholars often care not just (or primarily) about what a work is about but what theories and methods were applied. It is, at present, generally impossible to search by theory or method applied.

1.5 Advantages of separate schedules of relators

The inclusion of separate schedules of—generally verb-like—relators is one of the most unusual aspects of the BCC. This (and the schedules of properties that serve as adjectives or adverbs) allows the production of sentence-like subject strings. Documents can then be classified in terms of the main arguments made in the document. The classifier can move directly from a sentence in an abstract or book description to a subject string (Rules have been developed in Szostak 2017 to encourage the development of subject strings of typical grammatical format; see below). Since (almost) all humans spend their lives thinking and talking in sentences, they can more readily comprehend subject strings that follow a grammatical format. Moreover, a search interface can potentially move easily from a search query in the form of a sentence to a relevant subject string that resembles a sentence or sentence fragment.

The BCC can be used to classify ideas as well as documents. Ideas are generally expressed in the form of sentences. They are hard to capture accurately unless a classifier has recourse to schedules of relators (and properties). Less obviously, the BCC is also well-suited to the classification of objects. Again, a classifier can often move fairly quickly from a key sentence in an object description toward a subject string (for example (axe)(for)(war)), and user queries formulated grammatically can be translated into the relevant subject string.

The existence of schedules of relators facilitates the logical classification of phenomena. It is inconvenient, for example, to treat "recycling" in a classification that only addresses phenomena. Recycling is something that is done to phenomena rather than a type of phenomenon. One cannot treat a process such as "recycling" as a logical "type of" subclass of a thing (Mazzocchi et al. 2007). In the BCC, recycling is treated as a relator rather than a phenomenon. See Julien et al. (2013) for a discussion of hierarchical complexity in existing classification systems.

It is often maintained in the knowledge organization literature that different people might develop different classifications of phenomena. A classic example is that chemists may prefer a different classification of chemical elements to that preferred by pharmacologists. In the BCC, chemicals are classified as chemists would classify them. The interests of pharmacologists are captured synthetically; for example, (chemical)(for reducing)(blood pressure). This is only possible because of the schedules of relators that can connect chemicals and physiological outcomes.

1.6 The BCC and the tradition of facet analysis

For decades, the knowledge organization literature has advocated facet analysis (see Hjørland 2013). That is, classification systems should seek to capture the various facets by which documents might be distinguished. Facet analysis encourages a synthetic approach to classification in which different facets are combined in a subject string. The BCC captures each of the facets commonly identified in the literature; these turn out to be either particular types of phenomena (easily identified in the BCC schedules) or particular elements of a grammatically constructed subject string. In a sentence fragment such as (dogs)(bite)(mail carriers), it is clear that "dogs" is the subject, "bite" is the operation, and "mail carrier" is the object, as these facets are defined by the *Bliss's Bibliographic Classification*[3] (*BC2*) (Bliss n.d.). Szostak (2017) describes how each facet identified by Bliss is identified grammatically. The classifier need not explicitly perform facet analysis but merely translates a sentence(s) from a document description into a grammatical subject string. Sentences, we might note, are also faceted and synthetic, but we do not need facet indicators to communicate sentences; we immediately recognize the purpose of a verb without having to be told that it is a verb. By mimicking sentence structure, the BCC pursues facet analysis without facet indicators. The fact that the BCC schedules of things is organized around phenomena rather than disciplines is also important for it allows us to indicate certain facets such as "material" (again see Bliss n.d.) by simply employing the notation for the single schedule of materials within BCC.

Other classifications that take a faceted approach, such as the Integrative Levels Classification (2004), employ "facet indicators:" notations that inform the user which facet a particular piece of notation refers to. A subject string may then devote several notational spaces to facet indicators. Within a BCC subject string, facets are indicated either by a particular schedule of phenomena (such as materials) or a particular grammatical role (such as a verb). BCC subject strings can thus save notational space by eschewing facet indicators.

1.7 Philosophical justification of the BCC

Szostak, Gnoli, and Lopez-Huertas (2016) summarizes an extensive literature that argues for both the feasibility and desirability of a phenomenon-based comprehensive ("universal") classification. Philosophical justifications of the BCC in particular can be found in Szostak (2008; 2011; 2012; 2014a; 2014b; 2015a; and 2017).

Szostak (2011) made the key argument that complex concepts that might be understood quite differently across groups and individuals could generally be broken into basic concepts for which there was enough shared understanding

for the purposes of classification. Szostak argued that this hypothesis was consistent with most if not all of the major philosophical theories of concepts. He argued that practitioners of knowledge organization should seek consistency with a broad range of philosophical theories. He noted that for many philosophers, basic concepts represented real things (or relationships) that people observe (similarly) in the world around them. He urged a pragmatic and empirical approach; knowledge organization need not seek an unattainable elimination of terminological ambiguity but must merely explore whether ambiguity can be reduced to the level needed for particular classificatory projects.

Szostak (2015a) argued that any classification should be judged in terms of a variety of both philosophical and practical criteria. It argued that (a classification like) the BCC best reflects the nature of the works classified, since it captures the key arguments made in a work. Smiraglia (2001) had argued that the "nature of a work" should primarily be understood as the key ideas that the work contains; Szostak built upon this insight to stress the importance of sentences that would generally contain causal arguments. The BCC also signals to users the likely importance of a work (by potentially classifying theory, method and perspective applied, and the precise causal arguments investigated), addresses several challenges associated with hierarchy, meets ethical standards, responds to various concerns raised by the lived experience of librarians, and is able to attach formal definitions to natural language concepts.

The knowledge organization literature has often contrasted pre-coordinated classifications in which the classifier must choose from a set of (usually complex) subject terms with post-coordinated classifications in which the classifier can synthesize terms to create novel subject headings. Though a variety of advantages have been attributed to the post-coordinated approach taken by classifications such as the BCC, it has generally been argued that pre-coordinated systems allow greater precision. It is feared that a post-coordinated search for (history)(of)(philosophy) will yield many (irrelevant to the search) works on philosophy of history (Sauperl 2009). Szostak (2015a) argued that this is only true if we insist on search interfaces that do not discriminate based on the word order in search queries. Szostak had a group of computer science students develop a search algorithm that did prioritize the order of terms in the search query. A search for (history)(of)(philosophy) does then yield works on history of philosophy rather than philosophy of history. With the right search interface, then, the BCC can provide the advantages associated in the literature with both pre- and post-coordination. And a user can employ common grammar in a query and be guided to works that make an argument of similar construction.

Arguments that are more specific were made in other papers. Szostak (2008) argued that domain analysis—which urges classification within communities of shared understanding—could be interpreted and applied in a manner that facilitated cross-disciplinary classification. Szostak (2010) argued that domain analysis could be applied in comprehensive classification. That paper also applied work process analysis to show the advantages for interdisciplinary scholarship of a classification such as BCC. Szostak (2012) developed and justified the classification of relators employed in the BCC. A key argument here is that most works discuss relationships among two or more phenomena (things) and are thus best classified synthetically using relators. Szostak (2014a) argued that an approach such as that taken in the BCC could address many of the challenges noted in the literature around social diversity. The BCC might thus facilitate cross-group respect and understanding just as it is designed to facilitate interdisciplinary communication. Szostak (2014b) discussed how a classification such as BCC can improve the scholarly enterprise. In particular, by using a common vocabulary to classify works in terms of their key arguments, the BCC can identify precise conflicts between authors or disciplines (but also apparent conflicts that reflect terminological confusion rather than real differences of opinion) and often the sources of these. Knowledge organization could then serve as an antidote to extreme skepticism about the possibilities of scholarly understanding; identifying conflicts and recognizing their sources are the first steps toward transcending those conflicts. Szostak (2017 and elsewhere) argued that the BCC addressed a range of theoretical and practical concerns in the classification of museum artifacts. That article also explored the advantages of utilizing subject strings that follow standard grammatical formats.

2.0 The structure of the Basic Concepts Classification

The BCC has separate schedules of phenomena, relators, and properties.

2.1 The classification of phenomena

Though the vast majority of general (i.e., universal) classification systems employed in the world are organized around disciplines, the idea of organizing instead around phenomena (i.e., things) has long been advocated within the field of knowledge organization. The history of the idea of organizing by phenomena is reviewed in Szostak, Gnoli and Lopez-Huertas (2016, 96-100). One notable contribution was J.D. Brown's (1914) *Subject Classification*, reviewed in Beghtol (2004). The idea of classifying by phenomena has been applied in detail in recent years not only in the BCC but also in the Integrative Levels Classification (2004).

Phenomena within BCC are classified within seventeen broad classes. These reflect the idea of "integrative levels"

(Kleineberg 2017); phenomena of similar levels of complexity should be grouped together. There is thus a class of "waves and particles," another of "molecules and elements," two classes of complex natural objects, "rocks" (which includes a variety of earthly substances) and "celestial objects," a class of "non-human environment" that encompasses things like mountains and lakes, a class of basic "biological entities," a class of "flora and fauna," two classes that capture human nature, "genetic predisposition," and "individual differences," and several classes that capture elements of human society: "culture," "art," "politics," "economy," "social structure," "technology and science," and "health and population." There is also a class of "mathematical concepts." These seventeen broad classes are broadly similar to the twenty-six classes in the Integrative Levels Classification (http://www.iskoi.org/ilc/1/ilc.php), though different terminology is employed, and the BCC combines some ILC classes. In both cases the goal is to be exhaustive, designating one class into which each thing of which humans are aware can fit.

These classes were developed logically. There is some resemblance between classes and the subject matter of particular academic disciplines only because there is some logic to the structure of academic disciplines. But there is purposely no attempt to adhere to disciplinary boundaries; culture is addressed in one coherent class in BCC even though it is studied by several disciplines. A mixture of deduction and induction was used to identify subclasses. It was often fairly straightforward to identify these, in studying the economy one naturally is curious about such things as wages, prices, and unemployment rates. In some cases, classifications employed in a particular scholarly field were adapted for the BCC. While there are competing classifications of personality dimensions it was fairly easy to produce a classification for BCC that had a place for each of the dimensions emphasized in the major competing approaches. This represents a general strategy: to provide a logical structure in which all phenomena that are identified in the literature have a place. In a few cases, such as psychological disorders, it is more difficult to identify a classification that will not become outdated as psychological understanding changes.

The approach taken in identifying subclasses is similar to the approach recommended for "domain analysis" within knowledge organization (Hjørland 2017), which involves building a logical structure grounded on expert advice from within the domain. As was argued in Szostak (2010), and in Szostak, Gnoli, and Lopez-Huertas (2016, chapter 6), the procedures of domain analysis can be employed in pursuit of a general classification. It has generally not been difficult to render expert advice in terminology (i.e., basic concepts) that will have a broadly shared understanding—good enough for the purposes of guiding diverse users to documents or objects—outside of the field of the expert. The classificationist need not and should not take sides on theoretical disputes within a field but should rather seek a structure that has a place for any phenomenon identified either theoretically or empirically in the field.

Each class is indicated notationally by a capital letter. Where possible, these are the first letter of the class name: M for molecules and elements, R for rocks, C for culture, I for individual differences, and so on—but Z for celestial objects and X for mathematical concepts since C and M had been employed elsewhere. The first level of subdivision within each class is usually indicated by a second capital letter. Thus, CV represents values within the class of culture. Two exceptions have been made. The single letter T indicates the main subclass within "technology and science." These are among the most-used concepts in the classification, capturing elements of books, articles, and texts more generally. Likewise, the single letter N denotes the main class of "non-human environment," which includes common indicators of place and time.

The next level of subdivision employs numbers as notation. Lower-case letters indicate further levels of subdivision. CV1a is thus "ambition," within the subclass (1. "goals") of the subclass cultural values. It is thus easy to tell notationally what level of hierarchy one is dealing with. Note that we employ the first letter of subclasses—"a" for ambition—whenever possible.

Subdivision usually occurs in terms of "types of X." Values are a type of cultural attitude, goals are a type of value, and ambition is a type of goal. There are occasional exceptions where subdivision occurs in terms of "elements of X." These are clearly indicated. For example, "providence" is an element of CR, "religions."

As noted elsewhere, it was generally found that subdivision could follow logical principles. Literary warrant was pursued to ensure that any concept encountered in the literature found a place in the schedules. However, reliance on a synthetic approach to constructing complex subject strings, and the existence of separate schedules of relators and properties, meant that there was generally a clear logical place for any concept found in the literature (or found in other classifications; we talk about comparisons of BCC and UDC below, Szostak 2011 reported an extensive exercise of translating *DDC* classes and ICONCLASS into BCC; see https://sites.google.com/a/ualberta.ca/rick-szostak/publications/ddc-to-bcc-translation-table-web-version-2013). As the BCC is applied to collections of documents or objects, literary warrant can guide decisions as to whether further subdivision of subclasses is desirable. Note, though, that the synthetic nature of BCC subject strings generally allows a very precise classification of a document or object with recourse to flat hierarchies of phenomena.

Since BCC hierarchies are fairly flat, the notation for individual concepts is generally short; rarely are more than

four or five notational spaces involved. This means that it is possible to synthesize multiple concepts.

2.2 The classification of relators

As with phenomena, there is a tradition within knowledge organization of seeking to classify relators. Key works include Farradane (1967) and Perreault (1994). Szostak (2012) discusses this tradition. None of these previous efforts were successfully incorporated into a broader classification. The approach of the BCC differs from preceding efforts in stressing causal relators: relators that indicate some sort of influence of one thing on another (or itself). One insight guiding the BCC is the recognition that most works have some sort of "causal" argument wherein one or more phenomena exert some influence on one or more other phenomena: (dogs)(bite)(mail carriers). A couple dozen non-causal relators are also treated and each given a notation that is neither a number nor letter: "\" represents "for."

The classification of causal relators relies on synthesis to an even greater degree than other elements of the BCC. A few dozen relators are identified in a small set of very flat hierarchies. These are then combined with each other, or with phenomena or properties, in order to generate thousands of more complex relators.

All causal relators are signaled notationally by an arrow: "→" (sometimes pointing in the opposite or both directions to indicate the direction of influence). The arrow on its own can serve to indicate influence in general for cases where it is specified that one phenomenon influences another but not how. A set of more specific causal relators is then identified; each of these is given a notation of two lower-case letters: "→ma" is "assembling." There are three sets of "physical influences": mechanical (eight subclasses denoted by a first letter "m"), non-mechanical (eight subclasses denoted by a first letter "n"), and the four forces identified in nuclear physics as acting among sub-atomic particles (denoted by first letter "p"). There are three sets of "biological influences": evolutionary (four, denoted "e"), developmental (four processes critical to the development of organisms, denoted "d"), and a set focused on processes unique to at least some animals (eight, denoted "a"). There are three sets of "intentional influences" that can only be set in motion by a sentient being (even if they only influence themselves): influences that operate at the level of individuals (nineteen, such as believing "[→ib]," that are denoted by "i"), influences that operate between individuals (ten, each starting with "r" for relationship), and three of a spiritual nature that are not easily captured in the other two sets (and are denoted by "s"). There is also a set of general relators that transcend the three types of influence just mentioned (denoted by "g" and including "→ga" for "allowing"). Note that we have saved notational space by not indicating "biological," "physical," or "intentional" notationally but in each case indicating the three main subsets of these.

There is also a small set of five "changes within a phenomenon." These are sufficiently distinct from the causal relators between phenomena above that they are given distinct notations: "↑" for "increase" or "growth" or "development" (note that biological development is treated separately, because it involves qualitative changes of such a magnitude that organisms become different "things"), "↓" for "decline," "↕" for "fluctuations" or "cycles" or "alternation," "Δ" for "change" in general (intended to be linked synthetically to specific types of change), and "∩" for "stability of."

There are also some nineteen non-causal relators. Many of these are familiar in other classifications. Where possible, the BCC maintains notation already common within knowledge organization: "-" means "of" and "/" means "by" or "from." Round brackets signal "type of:" Y(X) means Y of type X. There are several more novel relators: ">" is "in," "!" is "about," ":" is "from the perspective of," "~" is "compared to," and "^" is "associated with" or "connected to."

Note that all relators of all types are signaled by symbols that are neither numbers or letters. It is thus clear in any subject string which terms are relators. These symbols are never used to denote phenomena or properties.

As noted above, the few dozen causal relators can be combined with other relators, phenomena, and things to generate literally thousands of other relators. The relators generated through synthesis are usually more precise. Two frequent forms of synthesis should be mentioned first. We can indicate the opposite of any verb by underlining the notation; we thus need not specify "destroy" but merely underline the notation for "create." Similarly, we can combine most relators with the notation for "again" (N2w) from the main class N in the schedules of phenomena to capture the whole set of relators that start with the letters "re-."

The most obvious form of synthesis involves combining two or more causal relators. We can generate "persuade" by combining "control" and "talk." Likewise, "force" combines "control" and "move." "Declare" is "decide" plus "talk." Dozens of similar combinations are listed on the BCC website but classifiers could generate others. In all cases, the notation simply combines the letters in the notations of the combined relators: "persuade" is "→rsrt" because "→rs" is "control" and "→rt" is "talk."

Causal relators can also be combined with non-causal relators. "attach" is (cause)(to be connected) or "→^" (note that we generally can ignore the phrase "to be" in synthesizing). "Assemble" is (create)(plus)(connect) or "→gc+^." Causal relators can also be combined with changes within a phenomenon. "Maintain" is (cause)(Stability) or "→∩." "Enhance" is (cause)(growth) or "→↑."

There are even greater possibilities for creating causal relators by combining relators and phenomena. "Injure" is

(cause)(injury). "Learn" is (achieve)(learning). "Classify" is (achieve)(classification)—which is quite different from (create)(classification). "Offend" is "cause resentment." The BCC website again lists dozens of possibilities but many more could be created.

Relators can also be combined with properties to generate further relators. "Suffer" is (experience)(bad). "Damage" is (cause)(damaged). "Compliment" is (talk)(complimentary). Dozens of such combinations can be found on the BCC website. More are possible. Finally, yet importantly, some relators can only be represented within causal strings. For example, "free" is (cause)(X)(not control)(Y). "Evict" is (move)(from)(home or office).

2.3 The classification of properties

The schedules of properties are similar in format and notation to the schedules of phenomena. They are distinguished entirely by the use of the capital letter Q (for "qualities") as the first letter in the notation for all properties. As with phenomena, the next level of subdivision is represented by another capital letter and the following level by numbers. There are, at present, seventeen types of property identified in the schedules, and these in turn are divided into between four and ten types. The types of property are quite diverse: aesthetic properties (QA) such as beautiful (QA1); behavioral properties (QB) such as anonymous (QB6); comparative properties such as more (QC5); evaluative properties such as popular (QE9); physical properties such as hard (QP1); or properties associated with values such as wasteful (QV7). The schedules were developed inductively as concepts were encountered in document descriptions, but then properties were grouped together, and similar types of property were added.

Hierarchies of properties are very flat. Notational length thus never extends beyond two upper-case letters and a number. In some cases, important opposites receive separate designations in the schedules (both "more" and "less") but in general, opposites are captured by underlining. This serves to keep the schedules of manageable size. Note that these properties can be employed synthetically as both adjectives and adverbs.

2.4 Synthesizing subject strings

Documents are described in abstracts or book descriptions. These often include a sentence or two that describe the main argument(s) made in the document. Objects in museums or galleries usually also have object descriptions; again, one or two sentences often describe the key characteristics of the objects. Ideas are commonly expressed in sentences. Whether dealing with a document, object, or idea, the classifier will generally then have recourse to a key sentence or two that describe the essence of the document, object, or idea. If not, the classifier will need to construct such a sentence(s) from longer textual materials. It is worth emphasizing that the BCC can, therefore, be applied very broadly to any object or idea or document that can be described in a sentence.

The classifier can then translate the key elements of the sentence into the terminology of the BCC choosing terms from the schedules of phenomena, relators, and properties. Such subject strings will almost always involve multiple phenomena, usually at least one causal relator, and often one or more adjective/adverbs. The classifier can ignore the elements of a descriptive sentence (determiners and most pronouns) such as "the," which are neither phenomena, relators, nor properties. If the sentence the classifier is drawing upon follows a typical grammatical construction, the classifier enters the BCC terms in the order they (or synonyms) appear in the sentence.

The resulting subject strings resemble the sentences from which they emerge far more than the typical subject headings associated with existing library classification systems (and thus BCC strings express facets in a different order than facet analysis tends to suggest). Knowledge organization professionals may thus find the subject strings unusual. Yet there are huge advantages to the grammatical approach. First of all, humans spend most of their lives speaking, talking, and reading in sentences. As a result, humans can more readily comprehend subject strings that read like sentences. In an age when some public libraries have abandoned library classifications because users found them difficult to navigate, the ease of use of the BCC is noteworthy. A user can enter a search query in a sentence and be guided to the most similar subject string—and that subject string will make sense to the user, because it is also in a grammatical format. Moreover, the subject string captures the essence of the document, object, or idea in question. It deserves to be stressed again here that the key element of a document is the ideas (usually in the form of causal relationships) that it contains. BCC subject strings capture key arguments. As for objects, a BCC subject string can capture the composition of an object, its mode of manufacture (and perhaps place and time), its use, and its cultural meaning: The classifier can be guided by the object description in determining which elements to stress in a subject string. A (golden)(ceremonial)(axe) can be distinguished from (steel)(axe)(for)(war). At present, it is very difficult to ascertain which museums might possess particular artifacts; widespread use of a classification such as BCC could facilitate such searches immeasurably. Moreover, a user could move easily between searching for documents about certain types of artifacts and the artifacts themselves.

The notation for (steel)(axe)(for)(war) is (TIt\→mbNMw)(MEFe)\ PI1 ↔rxgm PI1. TIt is tool. "\"

is "for." "→mb" is "break" or "cut." NMw is wood. MEFe is iron, and the parentheses around MEFe sugnal "of type." PI1 is state. "↔rxgm" is to engage in conflict in a manner that involves physical movement. As the BCC is applied it may prove advantageous to develop simpler notation for both "axe" and "war" than (tool)(for)(cutting)(wood) and (state)(physical conflict with)(state). BCC subject strings are usually less complicated than this. A classifier or user will ideally be guided by the search interface to know how to treat axe or war or any other term; in the absence of this interface, the BCC schedules are easy to search in order to identify appropriate terminology.

There are of course multiple ways that a particular idea might be expressed in words. The ability to translate a user query into a relevant subject string can be hampered by differences in both terminology and word order. Differences in terminology are best handled by a thesaural interface that can quickly suggest controlled vocabulary to a user. In the absence of such a thesaurus, the flat and logical nature of BCC hierarchies should facilitate the identification of controlled vocabulary.

Differences in term order can be handled by encouraging a standard grammatical format (recall that we want a search interface that prioritizes the word order of a search query; note though that such an interface would still identify works with a different word order if an unusual word order appeared in the query.) Szostak (2017) explored the literature on grammar and suggested that classifiers could follow about a dozen simple rules in translating a sentence from a document or object description into a BCC string that followed a recommended word order. These rules are simple enough—place adjectives before nouns, translate interrogative and exclamatory sentences into declarative format, use an extra pair of parentheses in the rare cases where it is not clear whether a term is adjective or adverb, and so on—that computers could potentially follow these rules, translating both user queries and document or object descriptions into a standard grammatical format.

We discussed above how BCC relies on "basic concepts" for which there are broadly shared understandings across individuals and groups. One key insight of the literature in the field of semantics is that sentences that follow a common grammatical format serve to reduce the ambiguity associated with individual terms in that sentence. We have seen examples of that above: the word "axe" on its own describes a set of artifacts that may differ in important ways; the placement of "axe" within a sentence or sentence fragment clarifies considerably the meaning attached to "axe" in a particular context. The BCC thus tackles the challenge of terminological ambiguity in two complementary ways; it relies wherever possible on basic concepts and then places these in subject strings that further clarify their meaning. Such an approach may be the best possible means of allowing individuals from different groups and backgrounds to use a shared classification to explore the entire universe of documents, objects, and ideas.

The BCC has been designed very much with a digital environment in mind. Nevertheless, BCC subject strings can be used if desired for shelf marks in libraries (or indeed museums). The classifier can bold the term in a subject string that should be prioritized for shelving purposes. Most of the time, this will likely be the first term anyway, for a document about "X influences Y" will be best grouped with other documents about X—but the classifier in a particular case may decide that it belongs with other works about Y. If we treat the notations associated with relators as if they were letters or numbers then we would collocate documents that describe how phenomenon X influences other phenomena, how it is compared to other phenomena, how it grows or declines, and so on.

In comparisons with both *DDC* (Szostak 2011) and UDC (Smiraglia and Szostak 2018), BCC strings were often found to provide greater precision. BCC strings tended to contain more distinct terms than UDC counterparts did. They were nevertheless similar on average in notational length, because the flat hierarchies of BCC generally yield short notations for individual terms. BCC terminology is often easy to understand. A notation such as "CV1e→PI2b" indicates to someone with a little familiarity with the system that the document in question discusses some sort of influence of a particular cultural value on a particular political institution.

Classifiers—and the institutions that employ them—can make decisions about how much detail to include in subject strings. From the perspective of users, more is generally better for they will still find a document if the subject string contains more adjectives than the search query but can increase precision with a very precise query. But longer subject strings will be somewhat more costly to produce—though this cost may be small if there is an appropriate thesaural and grammatical interface. In museums, especially, some institutions may decide to have shorter subject strings than others. Classifiers would then be more selective in translating sentences from an object description into a subject string. If that museum has artifacts that are unique in particular ways, short subject strings may fail to communicate that uniqueness to users, including users with very precise queries.

It is worth noting in closing that sentences are also synthetic constructs. We do not dictate the entire set of sentences that humans can utter but rather allow humans to combine words to create any ideas they desire. We are able to achieve innovations in many fields of human endeavor while only rarely adding words to any human language. It is expected that the synthetic approach taken with BCC will likewise allow the expression of diverse ideas while only

rarely requiring additions to its schedules (some adjustments may nevertheless be necessary if common understandings of some terms used in BCC change over time).

3.0 Advantages of the BCC

In addition to several advantages noted in passing above, the following advantages of the BCC could be stressed. It has been found that the BCC provides very precise descriptors of documents. As noted above, classifiers can capture the key elements of a document description by combining phenomena, relators, and properties synthetically. Smiraglia and Szostak (2018) compared dozens of subject strings between the BCC and the Universal Decimal Classification, finding the former to be more precise but of similar notational length.

As noted above, the terminology employed in the BCC reduces terminological ambiguity. Scholars of semantics note that sentences serve to clarify further the meaning of terms employed in the sentence; sentence-like subject strings thus further clarify meaning. The clarity of both basic concepts and subject strings should facilitate the translation of the BCC into languages other than English.

As noted above, a user query in the form of a sentence can potentially be translated directly into a relevant subject string.

A user performing an exploratory search might wish to make subtle changes to a search query. A search interface employing BCC could alert users to possibilities. For example, a user searching for (dogs)(biting)(mail carriers) could be alerted to documents addressing (cats)(biting)(mail carriers) or (dogs)(licking)(mail carriers) or (dogs)(biting)(neighbors). The user can thus easily follow their curiosity to a host of related subjects. This is much harder to do within precoordinated classifications. Note that the user can choose to alter nouns or verbs or adjectives/adverbs in their searches. The BCC thus instantiates a "web-of-relations" approach that allows users to find information related in a host of ways to the initial query.

The BCC is thus compatible with innovative visualization techniques. An interface could allow users to experiment with various sorts of changes to an original search query—perhaps by simply sliding a mouse over the different elements of the query. It could also guide users to related material; for example, from searching (dogs)(bite)(mail carriers) to (mail carriers)(go to)(hospitals).

Users and search interfaces could likewise easily move between broader and narrower terms in the hierarchies of phenomena (or properties). They could similarly move between simple relators and more complex relators formed via synthesis.

The BCC classifies scholarly theories and methods in some detail. It is thus possible to classify works in terms of theories and methods employed. If this were commonly done, users could then search for applications of particular theories or methods.

The semantic web relies on RDF triples of the form (subject)(predicate or property)(object). That is, the semantic web relies on resources being coded in terms of synthetic combinations of phenomena, verbs, and properties. As a result, the BCC is potentially well-suited to use on the semantic web. Szostak et al. (2018) are exploring this connection empirically.

Interdisciplinarity was the original motive for the BCC. Interdisciplinary scholars most often want to investigate the effects of phenomena studied in one discipline on phenomena studied in another. The BCC facilitates both the search for relevant documents and the communication of research results to diverse scholars who might be interested in the same relationship. Since the BCC provides detailed classifications of scholarly theories and methods, it can also potentially aid scholars interested in borrowing theories and methods from other disciplines. Note that general users are often also interdisciplinary in orientation and wish to discover relationships between phenomena without regard to the disciplines that may study these.

4.0 Further developments

The Basic Concepts Classification is still being developed. In particular, the schedules of natural science phenomena are slowly being expanded. In recent research, Smiraglia and Szostak (2018) have compared subject headings in the Universal Decimal Classification with those in BCC. The vast majority of the time the BCC schedules have already contained the concepts needed to capture the meaning of a UDC subject heading (often with greater precision). In a minority of cases, the BCC schedules have been expanded to facilitate comparison. The BCC has thus been developed to a point where it can be applied to collections of documents and/or objects. Further attempts to apply or compare the BCC will undoubtedly result in further smallish additions to the schedules. Suggestions regarding additions are most welcome.

The developer of the BCC believes that there is enough consensus—for the purposes of BCC—in most scholarly fields on how best to classify the things they study. The ease with which the BCC can be applied across diverse fields provides empirical support for this hypothesis. In some fields, though, such as the classification of psychological disorders, it is far less clear what the best approach is. In such cases the BCC website indicates that there is a challenge, and users are invited to suggest a path forward. The developer of BCC will also interact with field experts. In particular, Smiraglia and Szostak are planning to gather experts in music classification to improve the BCC treatment of mu-

'sical genres in particular and music more generally. One goal of this encyclopedia is to discuss best practices for classification in diverse fields, and the insights of other articles in this encyclopedia will naturally be incorporated into the BCC. Most of the elements necessary for a classification of authorial perspective (such as ethical and ideological attitudes) already exist within BCC. Others identified in Szostak (2015b) will be added.

The BCC is being translated into linked open data. As part of an international research grant, it and the UDC will be compared to the terminology employed at present in the LOD cloud (Szostak et al. 2018). The promise of the semantic web can only be realized if there is at least interoperability across the terminology employed in different online resources. It is hoped that the BCC and/or UDC can be useful in encouraging interoperability or use of a common vocabulary. The comparison of BCC terminology with the LOD cloud will also further identify areas in which the BCC schedules should be extended.

A better interface will also be developed to allow the BCC to be more readily applied to collections of ideas, documents, or objects. User testing can then be pursued to empirically assess the usefulness of BCC in providing access to collections. A prototype interface that prioritizes the order in which search terms are entered has already been developed, and work is proceeding on a thesaural interface. Though there are programming challenges in developing the sort of interface that has been mentioned at several points above, there does not appear to be any insurmountable barrier.

The fields of information retrieval and knowledge organization have developed separately in recent decades. Glushko (2013) is one of many authors who urges a reconciliation. He, like others, appreciates two huge challenges in standard approaches to information retrieval: 1) different texts employ different terminology for the same idea; and, 2) complex ideas are not well captured by searches for independent "bags of words." The interface envisioned here addresses both of these concerns; it will ideally translate a search query not just into controlled vocabulary but controlled vocabulary structured grammatically to match subject strings developed using BCC. It then will guide users to make small adjustments to their query if they wish. It thus promises to achieve far greater precision in search than existing information retrieval techniques are capable of (see Hjørland, 2012, for the general argument that subject classification can achieve greater precision than information retrieval techniques alone).

Ideally, the BCC would be accompanied by a thesaurus that would provide classifiers with clear advice on synonyms for BCC terminology. The reliance of the BCC on basic concepts should facilitate the construction of such a thesaurus. It might be structured in a similar manner to WordNet.

5.0 Limitations and criticisms

The BCC needs to be fleshed out in certain respects. Yet it also needs to be applied; only in application can the feasibility and desirability of the classification be adequately assessed. It has been conjectured above that the BCC has many advantages, and these have been borne out in small-scale applications to dozens of objects or documents, but the full advantages and limitations of the BCC can only be assessed in a larger-scale application. This is not an uncommon situation; classification systems tend naturally to be revised as they are applied. Nevertheless, there are challenges in simultaneously developing and applying a classification.

The BCC has been developed by one person, albeit with a great deal of advice from others. It lacks the bureaucratic support that some other classifications possess. These challenges may be best addressed as the system is applied to large collections of objects or documents.

We have touched above on various possible critiques of the BCC. Most obviously, is it true that the concepts employed in the BCC are really basic concepts? The BCC has now been developed to a degree that this hypothesis can be tested empirically. Does the structure of the BCC somehow penalize documents that pursue theories that might organize the world differently? Though the BCC strives to find a logical place for all concepts, this question can really only be evaluated empirically as the BCC is applied to a large and diverse corpus of documents. Recall, though, that the standard by which the BCC should be evaluated is not perfection but whether it performs better than other classifications.

The BCC unfortunately follows the practice of most of the world's general classifications in not providing detailed notes on which sources were used in developing the classification. For example, which psychologists were consulted (and why) in developing the classification of personality dimensions? Such notes would allow others to better evaluate the system and in particular to appreciate whether it reflects the latest thinking among scholars. Such notes might also signal possible gaps or biases in the classification. The author appreciates that it would be useful to add such notes in the future. In the meantime, the application of the BCC to a wide range of (especially recent) documents and objects can serve to identify any necessary additions to the schedules; only very rarely in the developer's experience has there not been an obvious place to put such additions.

Notes

1. Broughton (2015, 383) "facet indicator a notational symbol used to indicate a particular element of a compound subject: e.g. in DDC, 09 is used to introduce place, and in UDC = indicates the language of the document." See further in Broughton (2015, 323-6).

2. https://sites.google.com/a/ualberta.ca/rick-szostak/research/basic-concepts-classification-web-version-2013/guiding-principles
3. Broughton (2015, 376): "Bliss's Bibliographic Classification is a scheme often regarded as the most scholarly of the general schemes. It was never used in Bliss's native America, but was favoured by a number of UK and Commonwealth academic and special libraries. Because of its unique main class for social welfare, the first edition, *BC1*, was widely adopted by many charity and social welfare libraries in the UK. The second edition, *BC2*, is the only general scheme built on faceted principles published in the Western world."

References

Bliss Classification Association. n.d. "The Classification BC2." https://www.blissclassification.org.uk/bcclass.shtml

Beghtol, Clare. 2004. "Exploring New Approaches to the Organization of Knowledge: The Subject Classification of James Duff Brown." *Library Trends* 52, no. 4: 702-18.

Broughton, Vanda. 2015. *Essential Classification*. 2nd ed. London: Facet Publishing

Brown, James Duff. 1914. *Subject Classification, with Tables, Indexes, etc., for the Sub-division of Subjects.* 2nd rev. ed. London: Grafton.

Classification Research Group. 1969. *Classification and Information Control.* London: Library Association.

Farradane, Jason. 1967. "Concept Organization for Information Retrieval." *Information Storage and Retrieval* 3: 297-314.

Fox, Melodie J. DATE "Review of Szostak 2003 and 2004." *Knowledge Organization* 39: 300-3.

Glushko, Robert J., ed. 2013. *The Discipline of Organizing.* Cambridge: MIT Press.

Gnoli, Claudio. 2016. "Classifying Phenomena. Part 1: Dimensions." *Knowledge Organization* 43: 403-15

Gnoli, Claudio. 2017a. "Classifying Phenomena. Part 2: Types and Levels." *Knowledge Organization* 44: 37-54.

Gnoli, Claudio. 2017b. "Classifying Phenomena. Part 3: Facets." In *Dimensions of Knowledge: Facets for Knowledge Organization*, ed. Richard Smiraglia and Hur-Li Lee. Würzburg: Ergon, 55-67.

Gnoli, Claudio. 2018. "Classifying Phenomena. Part 4: Themes and Rhemes." *Knowledge Organization* 45: 43-53.

Hjørland, Birger. 2012. "Is Classification Necessary After Google?" *Journal of Documentation* 68: 299-317. doi: 10.1108/00220411211225557

Hjørland, Birger. 2013. "Facet Analysis: The Logical Approach to Knowledge Organization." *Information Processing and Management* 49: 545-57. doi:10.1016/j.ipm.2012.10.001

Hjørland, Birger. 2017. "Domain Analysis." *Knowledge Organization* 44: 436-64.

"Integrative Levels Classification." 2004-. www.iskoi.org/ilc/

Julien, Charles-Antoine, Pierre Tirilly, Jesse Dinneen and Catherine Guastavino. 2013. "Reducing Subject-Tree Browsing Complexity." *Journal of the American Society for Information Science & Technology* 64: 2201-23.

Kleineberg, Michael. 2017. "Integrative Levels." *Knowledge Organization* 44: 349-79.

Mazzocchi, Fulvio, Melissa Tiberi, Barbara De Santis and Paolo Plini. 2007. "Relational Semantics in Thesauri: Some Remarks at Theoretical and Practical Levels." *Knowledge Organization* 34: 197-214.

Perreault, Jean M. 1994. "Categories and Relators: A New Schema." *Knowledge Organization* 21: 189-98.

Sauperl, Alenka. 2009. "Precoordination or Not? A New View of the Old Question." *Journal of Documentation 65:* 817- 33.

Smiraglia, Richard. 2001 *The Nature of "a Work;" Implications for the Organization of Knowledge.* Lanham, MD: Scarecrow Press.

Smiraglia, Richard and Rick Szostak. 2018. "Converting UDC to BCC: Comparative Approaches to Interdisciplinarity" In *Challenges and Opportunities for Knowledge Organization in the Digital Age: Proceedings of the Fifteenth International ISKO Conference, 9-11 July 2018 Porto, Portugal,* ed. Fernanda Ribeiro and Maria Elisa Cerveira. Advances in Knowledge Organization 16. Baden-Baden: Ergon, 530-8.

Szostak, Rick. 2003. *A Schema for Unifying Human Science: Interdisciplinary Perspectives on Culture.* Selinsgrove, PA: Susquehanna University Press.

Szostak, Rick. 2004. *Classifying Science: Phenomena, Data, Theory, Method, Practice.* Dordrecht: Springer.

Szostak, Rick. 2008. "Classification, Interdisciplinarity and the Study of Science." *Journal of Documentation* 64: 319-32.

Szostak, Rick. 2010. "Universal and Domain-specific Classifications from an Interdisciplinary Perspective." In *Paradigms and Conceptual Systems in Knowledge Organization: Proceedings of the 2010 conference of the International Society for Knowledge Organization* Rome, February, 2010, ed. Claudio Gnoli and Fulvio Mazzochi. Advances in Knowledge Organization 12. Wurzburg: Ergon, 71-7.

Szostak, Rick. 2011. "Complex Concepts into Basic Concepts" *Journal of the American Society for Information Science & Technology* 62: 2247-65.

Szostak, Rick. 2012. "Classifying Relationships" *Knowledge Organization* 39: 165-78.

Szostak, Rick. 2014a. "Classifying for Social Diversity" *Knowledge Organization* 41: 160-70.

Szostak, Rick. 2014b. "Skepticism and Knowledge Organization" In *Knowledge Organization in the 21st Century: Between Historical Patterns and Future Prospects; Proceedings of the 2014 Conference of the International Society for Knowledge Organization Krakow, May, 2014*, ed. Weislaw Babik. Advances in Knowledge Organization 14. Wurzburg: Ergon, 57-64.

Szostak, Rick. 2015a. "A Pluralistic Approach to the Philosophy of Classification" *Library Trends* 63: 591-614.

Szostak, Rick. 2015b. "Classifying Authorial Perspective." *Knowledge Organization* 42: 499-507.

Szostak, Rick. 2016. "Employing a Synthetic Approach to Subject Classification across Galleries, Libraries, Archives and Museums." In *Knowledge Organization for a Sustainable World: Challenges and Perspectives for Cultural, Scientific and Technological Sharing in a Connected Society. Proceedings of the Fourteenth International ISKO Conference Rio de Janeiro, Brazil, September 27-29, 2016*, eds. J. A. Chaves Guimarães, S. Oliveira Milani and V. Dodebei. Advances in Knowledge Organization 15. Würzburg: Ergon, 359-67.

Szostak, Rick. 2017. "A Grammatical Approach to Subject Classification in Museums." *Knowledge Organization* 44: 494-505.

Szostak, Rick, Claudio Gnoli and Maria López-Huertas. 2016. *Interdisciplinary Knowledge Organization.* Berlin: Springer.

Szostak, Rick, Andrea Scharnhorst, Wouter Beek and Richard Smiraglia. 2018. "Connecting KOSs and the LOD Cloud." In *Challenges and Opportunities for Knowledge Organization in the Digital Age: Proceedings of the Fifteenth International ISKO Conference, 9-11 July 2018 Porto, Portugal,* ed. Fernanda Ribeiro and Maria Elisa Cerveira. Advances in Knowledge Organization 16. Baden-Baden: Ergon, 521-9.