Abstract—Many important (particularly industry) solutions to research problems are included in patents, but not in academic publications. We studied patents invented by researchers associated with the annual IEEE/IFIP Business-Driven IT Management (BDIM) workshops and selected for in-depth analysis 4 granted patents and 19 pending patent applications most closely related to BDIM topics. These patents address diverse applications, most commonly resource allocation and contract management. Similarly, they have diverse official classifications, most often the International Patent Classification classes G06Q 10/00 and G06F 17/60 and the US Patent Classification class 705/7. We found that all analyzed patents were invented by either IBM or HP employees and determined the most prolific inventors, both those associated with the BDIM workshops and additional co-inventors. Our year-by-year analysis indicates some growth in interest in BDIM-related innovation. By examining citations by and of the studied 23 patents, we found additional BDIM-related patents. We also concluded that only 4 patents emphasize ease of operation, important for crossing the chasm between early and mainstream customers. Additional information and insights about the BDIM area from our study complement the past academic literature surveys and can guide future patent analyses.

Index Terms—business-driven IT management, literature survey, patent, patent survey, patent analysis

I. INTRODUCTION AND MOTIVATION

The traditional information technology (IT) system and service management approaches mainly focus on functional correctness and optimization of technical metrics, such as response time and availability. However, business metrics, such as profit and market share, are more important to business users of IT systems than technical metrics. For example, if the response time of a service changes from 10ms to 30ms, a business user is usually not very interested in the precise new response time, but wants to know the business impact of this change, e.g. how much it will cost her/his business.

Business-driven IT Management (BDIM) [1], [2] is a research area in which IT system/service management decisions are made based on both business and technical metrics in order to maximize business value. While the need for the management of IT systems and services from the business (instead of technical) viewpoint has been known for several decades (it is an aspect of the broader problem of insufficient business-IT alignment), the interest in it increased in the early 2000s. After a number of BDIM-related publications in various venues, the interested researchers established in 2006 the annual Business-Driven IT Management (BDIM) workshops [3], [4], [5], [6], [7] at IEEE/IFIP Network Operations and Management (NOMS) and Integrated Management (IM) conferences.

Researchers (particularly graduate students in early research phases) often conduct literature surveys (a.k.a. literature reviews) to determine the state of the art. Unfortunately, they very rarely include granted patents and pending patent applications (still under examination). On the other hand, many important (particularly industry) solutions to research problems are included in patents, but not in academic publications analyzed in academic literature surveys. The most well known literature surveys in the BDIM area were published in proceedings of BDIM workshops [1], [2]. These literature surveys and (even more importantly) each of the papers published in BDIM workshop proceedings 2006-2009 [3], [4], [5], [6] do not reference a single patent. Yet, BDIM-related topics attracted industry attention and, as this paper will show, there are important BDIM-related patents.

There are different types of patent analysis. The one most closely related to academic literature surveys is intellectual property (IP) landscaping, which is the analysis of intellectual property (particularly patents) within a certain area to determine previously patented subject matter, inventors and patent assignees (usually inventors' employers), relationships between competitors, patenting trends, potential "white spaces" for future research and innovation, and other information about the state of the art. An example of IP landscaping is given in [8]. Furthermore, the patents to be analyzed can be searched for in several different ways [9]. Oftentimes, patents are searched using a combination of keywords. However, if the search terms have many synonyms (terms with same/similar meaning) and terminological homonyms (the same words that have different meaning, e.g., in different research areas), the keyword-based search is not very efficient.
and has to be complemented with additional search types. In particular, if names of potential patent authors/inventors (e.g., leading researchers in an area) are known, they can be used for targeted search of patents from these inventors, which in turn can provide information (e.g., frequent classification numbers) that can focus (narrow) keyword-based searches.

Unfortunately, BDIM is one of the areas where different authors/inventors relatively frequently use different terms describing similar concepts (e.g., “business metric” and “key performance indicator – KPI”) and where the key terms (e.g., “business metric”, “optimization”, “service”, “management”) are also used across many other scientific areas and market segments, sometimes with significantly different meanings. We initially conducted a patent search using the main keywords in BDIM academic publications. However, this search returned a very diverse set of patents, only the small percentage of which turned out to be closely related to BDIM. We realized that it would be useful for understanding of the BDIM patent landscape to conduct analysis of patents invented by leading BDIM researchers. Thus, this paper provides an analysis of patents by the core of the BDIM research community – BDIM workshop organizers, Program Committee members, and paper authors. It references 30 BDIM-related patents and provides other information and insights about the BDIM area, which were not mentioned in the past academic publications.

In this section, we provided the general introduction into and motivation for our research. In the next section, we provide some background information about patents, patent analysis methods, and patent search methods. The methodology and the main results of our patent analysis are presented in Section III. Then, we discuss limitations of our study. In the last section we summarize conclusions and outline how the results of our patent analysis can be used for additional studies.

II. PATENTS, PATENT ANALYSIS, AND PATENT SEARCHING

Patent law is a very complex area, with significant differences among countries. While academic literature surveys and analyses are regularly taught to academic researchers in information and communications (ICT) technologies (e.g., within senior undergraduate or early graduate courses), issues related to patenting are still taught and discussed rarely (e.g., only through relatively short overview presentations sessions). This section contains a brief introduction into patents, patent analysis, and patent searching. It is aimed only as a help to readers (e.g., academic researchers) who are not familiar with patents to understand the (landscaping) patent survey presented in this paper. For more precise and detailed information about patents and patent searches, the readers should consult appropriate literature, such as [9], [10], and IP professionals.

A patent is a government grant that allows inventors or assignees (to whom inventors pass patent rights) to prohibit others from practicing the disclosed invention for a limited time (usually 20 years) after the priority date (usually the date of first application filing). After the patent expiration, the invention becomes public property and may be practiced freely. To be patentable, the invention must be of patentable subject matter (e.g., software could be patentable in the USA, but not in many other countries), novel, inventive (incl. non-obvious), and useful. The inventors must fully describe the invention to the public in a patent specification, which is a legal document with a prescribed structure. The main parts of a patent specification are usually: title, abstract, various bibliographic information (e.g., patent grant or application numbers, inventors, assignees, patent classifications, filing date, priority dates, etc.), drawings, technical field of the invention, background, summary of the invention, description of drawings, description of preferred embodiments, and claims. The term “patent” is commonly used for specifications of both granted patents and pending patent applications (document structure is the same), but a pending application is not yet a legally valid patent.

The process to obtain a patent differs between countries. In principle, inventors have to submit separate applications in different countries. However, under international conventions patent applications for the same invention in different countries can (under certain conditions) use the date of the first among these applications as the priority date. A patent family is a group of patents claiming the same priority date. Apart from patent applications for the same invention in different countries, in some cases somewhat different, but related, patent applications in the same country can belong to the same patent family. This is the case with continuing (divisional, continuation, or continuation-in-part) patent applications.

In most cases, patent applications are published by a patent office only 18 months after the filing date. This period enables inventors to build products based on their inventions and work on follow-up inventions. However, this means that for about 18 months the patent application is hidden from the public and competitors, so patent searches (which cannot find unpublished applications) discover only the state of the art from 18 months ago. Patent searches should be updated regularly.

Since the patent examination and granting process is complicated and usually lasts several years, it is common that there are many recent published patent applications that are not yet granted patents. There are often several revisions of a patent specification during the patent examination process. In References, we list the latest relevant patents (with the first application in the same family, if different) and any continuing applications. We list priority dates and not publication dates, because patent priority dates are much more important.

Patent analysis is performed for various reasons, so there are different types of patent analysis. Classifications of patent analyses that can be found in the literature vary, both in terminology and in granularity of classification. However, it is important to note that this paper is on IP landscaping (of the BDIM area), as introduced in the previous section. Related to IP landscaping is strategic analysis of patent portfolios. Its main goals are to: analyze patenting activities of competitors, identify technological trends, see how past patents fit with market needs, discover relevant unexplored or underexplored areas for further research, determine at which technology level there are unsolved problems, and provide other information for strategic decisions on positioning own research, patenting, and development activities for success in the marketplace. An
example of strategic patent analysis is [11]. While both IP landscaping and strategic analysis of patent portfolios can be performed without having yet a particular own invention in mind, other types of patent analysis are performed after some own research in an area is already done. Particularly, the goal of prior art analysis is to determine what has already been done and published (in patents, but also other literature such as academic research papers) on a particular topic, e.g., to determine novelty of own solutions (which is necessary for patenting). The goal of freedom to operate patent analysis is to determine whether a particular solution infringes on some existing patents (and which ones) and to help in decisions whether to pursue further development and commercialization of this solution. For freedom to operate analysis, claims are the most important part of patent specifications, while invention descriptions are more important for prior art analysis.

As mentioned in the previous section, a common type of patent searches is based on a combination of keywords. Since different inventors use different terminology, it is important to carefully design keyword-based searches by taking into consideration synonyms and homonyms. Even then, keyword-based searches might not provide appropriate results in some areas (as we found to be the case with BDIM). Other types of searches are based on examining various bibliographic information in patents [9]. We find that search by known inventors is particularly useful and this paper is based on such a search. This type of search finds all patents by a group of known inventors and from the found patents it selects information for further search and analysis. Searching by assignee is similar, but (unless focused with additional search criteria) it is more useful when studying small companies with limited patent portfolios than big international companies. Another type of patent search is by official classifications, most commonly the International Patent Classification (IPC) [12] and the US Patent Classification (USPC) [13]. It searches for all patents within the given subclasses. However, some subclasses have a large number of patents in them, making reading all of them impractical. In such and many other situations, it is very useful to combine search criteria to focus the search. For example, searches by patent classifications can be combined with keyword-based search and/or searches by inventor/assignee. Yet another type of patent search is based on finding which documents (patents, but also other literature) are cited by a given patent or in patent examiners’ search report for this patent application (this is backward patent search) and also which newer documents (e.g., subsequent patents and search reports) cite the given patent (this is forward patent search). Such search enables examining relationships between inventions described in patents, as well as identification of important patents.

Patent titles are often deliberately vague, so they should not be used for patent analysis. In principle, patent abstracts should be representative summaries of the contained inventions. Unfortunately, this is not always the case in practice. Sometimes classifications provided in a patent application are also not fully appropriate. Some commercial patent databases add their own abstracts or classifications, when they find that the ones provided in a patent application are unsatisfactory.

III. ANALYSIS OF BDIM-RELATED PATENTS

Our analysis is based on the search of patents (both granted patents and pending patent applications) from known inventors. We assumed that the majority of BDIM experts and potential patent inventors in the BDIM area are in some way associated with the BDIM workshops. By analyzing the BDIM workshop proceedings 2006-2009 [3], [4], [5], [6], [7], we found that 168 researchers are associated with the BDIM workshops, as co-organizers, Program Committee members, or paper authors. In November 2009, we used the commercial patent software QPAT 7.0 [14] to find patents where at least 1 of these researchers is listed as an inventor and there were 736 hits (without removing duplicates). We examined the found patents to determine whether they were “closely related to BDIM” and selected for in-depth analysis only 23 that we deemed to satisfy this criterion. (Note that the criterion for “closeness” to BDIM is somewhat subjective. At first we selected 31 patents, but later strengthened our criterion. We discuss study limitations in the next section.) In cases when there was more than 1 patent in a family, we studied the latest one from the country where the first application was made. We analyzed these 23 patents by patent status, assignee, year of priority, official classifications, actual application area (in our opinion), inventors, and emphasis on ease of operation. We also examined citations by and citations of these 23 patents.

A. Analysis by Patent Status, Assignee and Year

Among the 23 patents that we analyzed in mid November 2009, only 4 [15], [16], [17], [28] were granted patents in the USA, while the other 19 [18-27, 29-37] were pending patent applications (still under examination). (By mid February 2010, [34] was granted in the USA and [23] was granted in China. Additional grantings can be expected soon.) The primary causes for this disproportion are relative novelty of the BDIM area and the long duration of the patent examination process.

Whenever there is an assignee on the studied 23 patents, it is either IBM (International Business Machines Corporation) or HP (Hewlett-Packard Development Company). On some patents assignee is not yet specified, but we used the informa-
We expect that these patents will soon be assigned to the employer, so hereafter we treat them as belonging to IBM or HP. Thus, IBM has 16 patents (4 granted, 12 applications), while HP has only 7 patents (all applications).

Since IBM and HP are huge international companies with thousands of patent applications per year, it is impractical to conduct a patent search using only assignee information. To study patenting activities and strategies of such big companies, it is necessary to focus (narrow) patent searches by several additional criteria, such as patent classes and keywords.

We also examined continuing patent applications and found 9 (7 continuations, 2 divisionals) by IBM and 1 by HP. The existence of a continuing patent application could indicate value of the continued application, so the relatively large number of continuing applications is encouraging. We considered all priority dates (incl. continuing applications) as well as assignees in our year-by-year analysis and the results are shown in Figure 1. Note that since we did our research in November 2009 and most applications are published 18 months after filing, only the first half of 2008 is covered. Although there are years with little activity (2002 and 2005), the strong activity in the first half of 2008 indicates to us some growth in interest in BDIM-related innovation. It might be relevant to note that the activity after 2006 is almost completely by IBM, while HP submitted only 1 relevant patent application.

![Figure 2. Number of patents per IPC or USPC patent classification](image)

B. Analysis by IPC and USPC Classifications

Figure 2 shows how the topics of the studied 23 patents were most frequently classified according to the international (IPC) and US (USPC) patent classifications. The USPC subclass 705/7 ("Data processing: financial, business practice, management, or cost/price determination – Operations research" [13]) is the most frequent (it was used 7 times). Another common USPC subclass is 705/1 ("Data processing: financial, business practice, management, or cost/price determination – Automated electrical financial or business practice or management arrangement" [13]). Among IPC classifications, the most common are G06Q 10/00 ("Data processing systems or methods, specially adapted for administrative, commercial, financial, managerial, supervisory of forecasting purposes; systems or methods specially adapted for administrative, commercial financial, managerial, supervisory or forecasting purposes, not otherwise provided for – Administration, e.g. office automation or reservations; management, e.g. resource or project management" [12]) and G06F 17/60 ("Electric digital data processing – Transferred to G06Q" [12]). Only classifications used more than 1 time are shown in Figure 2, but there are 20 additional classifications used only 1 time. Due to the space limitations, we will not write here all definitions of IPC and USPC subclasses shown in Figure 2, but they are available at [12] for IPC and [13] for USPC.

Note that Figure 2 is according to classifications in patents, which usually specify only 1 IPC and 1 USPC subclass. We also found additional classifications, primarily IPC, added in patent databases. When these are counted, G06Q 10/00 and G06F 17/60 are again the most common IPC classes with 12 and 9 occurrences, respectively. In this case, the total number of used IPC and USPC classifications increases substantially.

We also studied IPC and USPC classifications of the 9 patents from 2008, to check for any recent trends. The IPC subclass G06Q 10/10 and the USPC subclass 705/7 were also the most popular in 2008. We do not see any real trend in 2008.

This information about common patent classifications can be used for finding additional BDIM-related patents. Unfortunately, the top subclasses from Figure 2 contain too many patents (e.g., G06F 17/60 has 132,901 patents) for exhaustive analysis. It is more manageable to use the information about patent classifications for focusing keyword-based searches. For example, limiting the keyword search for “business value” to the USPC subclass 705/7 results in only 13 hits, while limiting it to the IPC subclass G06Q 10/00 results in 36 hits.

![Figure 3. Number of patents per application area](image)
C. Analysis by Application Area

In addition to examining the common IPC and USPC classifications, we read the patents and tried to determine their primary application area (1 per patent). We identified that: [18], [23], [24], [17] are on resource allocation, [15], [16], [28], [37] are on contract management, [29], [31], [35] are on business process monitoring, [22], [25], [36] are on business process management, [20], [21] are on fault/incident management, [26], [32] are on change management, [19], [34] are on hardware/software selection, [27] is on planning, [33] is on value estimation, and [30] is on service management. Figure 4 shows the number of patents per application area for IBM and HP. The most common application areas are resource allocation and contract management with 4 patents each, while business process monitoring and business process management have 3 patents each. Note that our classification differs from the official classifications discussed in the previous subsection. Notably, only 2 patents [23], [24] are officially classified with subclasses on resource allocation, while we found 2 other patents [18][16], [17] in this application area.

In the 9 patents from 2008, the most common application areas were resource allocation, business process management and change management with 2 patents each. (There are no patents on change management in other years, while in 2008: 1 IBM, 1 HP.) The other 3 patents from 2008 are on business process monitoring, value estimation, or service management.

D. Analysis by Inventors

We found that 64 of the 168 researchers associated with the BDIM workshops invented patents. As mentioned previously, all inventors on the patents that we found “closely related to BDIM” were with either IBM or HP. While there are academic researchers in the list of 64 patent inventors, none of their patents is close to BDIM (according to our criteria). The fact that there is no independent inventor from academia on BDIM-related patents is disappointing to us, but it is not surprising because academics often do not patent their work.

Figure 4 shows the members of the BDIM workshop community who have 2 or more BDIM-related patents. S. Kumaran (IBM), M. Sallé (HP), and K. Bhattacharya (IBM) are the top 3 inventors in this list. Note that the list of prolific inventors becomes significantly different if all their patents are counted (and not only those that we deemed to be “closely related” to BDIM). Then, G. Y. Grabarnik, J. Wilkes, and J. O. Kephart are the most prolific inventors.

![Figure 4. Number of patents per inventor active in the BDIM workshops](image)

We also determined co-inventors (of the 23 studied patents) who had not published academic papers in BDIM workshops. Figure 5 shows such inventors who have invented at least 2 patents from our list. We examined further all patents invented by the top 2 inventors from Figure 5: K. Bhaskaran and S. Kapoor (both from IBM). K. Bhaskaran invented 17 patents (incl. 4 in our set of 23 BDIM-related patents), while S. Kapoor invented 15 (incl. 4 BDIM-related already in our set). We read their remaining patents and concluded that at least 2 of them [38], [39] satisfy our criterion for “close to BDIM”. In this way, we have used the information about co-inventors to discover new BDIM-related patents.

![Figure 5. Number of patents per inventor not active in the BDIM workshops](image)
Furthermore, we analyzed in which application areas (from Section III.C) each of the inventors (both those associated with the BDIM workshop and their co-inventors) has patents. Table I shows this information for the inventors that have at least 3 patents among the 23 patents we analyzed. (Due to the space limits, we cannot show in this paper such information for the other inventors. More complete data sets for all analyses presented in this paper are available from the authors.)

The information about prolific inventors can be used to focus keyword-based searches, as explained for using patent classes. It can also be used for setting of alerts in advanced patent databases/tools. Such alerts automatically send e-mail about any database additions/changes that match given criteria, such as inventor names (possibly in combination with other filtering information). While setting alerts for a large number of inventors might not be appropriate, setting alerts for a limited number of key inventors is useful.

E. Analysis of Backward and Forward Citations

As mentioned in Section II, the purpose of the analysis of backward citations (i.e., “by” the given patent) and forward citations (i.e., “of” the given patent) is to see relationships between inventions described in the patents, determine which patents seem important (have many forward references), and find relevant patents that were not discovered by other searches.

Our citation search of the 23 studied BDIM-related patents found in total 44 cited patents (backward citations) and 57 citing patents (forward citations), excluding citations within the same patent family. None of the 44 cited patents was cited in more than 1 BDIM-related patent (i.e., we were not able to find any commonly cited prior patent). The BDIM-related patents [16], [15], [19] contain most citations: 11, 8, and 5, respectively. 13 of the 23 analyzed BDIM-related patents are cited by newer patents, with [35], [16], [24], [36], [19] being cited most often: 8, 7, 4, 4, and 4 times, respectively. This higher number of forward citations might indicate importance of the latter 5 patents in the patent portfolio of their companies (the first 4 are from IBM, the last is from HP). We read the new patents found through this backward and forward citation search to determine their closeness to BDIM. While many of these patents have some relationship to BDIM, only 3 [40], [41], [42] among 44 patents from backward citation search and only 2 [43], [44] among 57 patents from forward citation search satisfied our criterion of “close to BDIM”, as used in this patent survey. This study also found a new assignee – [43] is assigned to Software AG. (Also, [41] is not yet assigned.)

We were surprised that the forward citation search found more citations than the backward citation search. This might indicate that (at least some) BDIM-related patents are valued. However, we were disappointed that only 2 of the 57 patents from the forward citation search are “close to BDIM”. This indicates that (at least some) BDIM-related patents are used as building blocks in other solutions, rather than for continuation of BDIM-related innovation. One of the reasons might be the difficulty in developing viable BDIM solutions (e.g., in mapping between technical and business metrics).

F. Analysis by Emphasis on Ease of Operation

In the area of marketing of high-tech products, the Technology Adoption Life Cycle classifies customers according to their reaction to discontinuous innovation [45]. The 5 customer classes are: technology enthusiasts (innovators), visionaries (early adopters), pragmatists (early majority), conservatives (late majority), and skeptics (laggards). Their distribution is approximately according to the bell curve, representing a standard deviation from the norm (between pragmatists and conservatives). Thus, the pragmatist and the conservative group are each about 1/3 of all customers, the number of skeptics and visionaries is much smaller, while the number of technical enthusiasts is very low. Customers from different classes look for different product features in their buying decisions. Moore has noticed [45] that many high-tech firms are unsuccessful in the transition from the small early market (technology enthusiasts and visionaries) to the much larger and more profitable mainstream market (pragmatists and conservatives), because their products are not adapted for mainstream market customers. These companies “fall into a chasm” [45] between early and mainstream customers, during which their sales stagnate or are reduced. To capture the mainstream market it is important to build into products features important for mainstream customers and to protect these solutions through patents.

An important such feature is ease of operation. While early market customers for BDIM products are predominantly motivated by improved business performance of BDIM-related products (compared to traditional IT system and service management tools), mainstream customers also require ease of operation. While autonomic/self-management capabilities provide easier operation, they are not the only aspect that has to be considered here. This is because BDIM (and particularly autonomic BDIM) requires development and instantiation of various complex models that bridge technical and business metrics, as well as high-level business goals and low-level technical IT management actions. If it is difficult for users (particularly business, not technical, people) to build such models for their systems and to provide necessary model data (e.g., various estimates, probabilities, weights), the pragmatist customers will probably not buy BDIM products.

Our analysis of the 23 BDIM-related patents found that only 4 among them [15], [27], [28], [35] put sufficient emphasis on ease of operation. (These patents often also put emphasis on other features, primarily improved business performance.) Additional 9 patents mention some support for ease of operation, but (in our opinion) without providing enough details. The other 10 patents do not consider ease of operation. This analysis indicates that improvement of ease of operation could be a domain of useful further research and patenting.

IV. LIMITATIONS OF THIS STUDY

An obvious limitation of this study is that determining whether a patent is “close to BDIM” or not is somewhat subjective, although we have tried to rely on the established definitions of the BDIM area [1], [2]. In many cases, it is possible
to argue both ways and we were sometimes in doubt what to do. We first experimented with a more inclusive approach, but then decided to strengthen our criterion. If we have included in our analysis some additional patents, maybe some of our insights would have been different (but we believe that the BDIM patent landscape picture is more realistic with the approach we took). In order to reduce subjectivity, 2 people independently made inclusion/exclusion decisions: the primary decision maker based them on reading the full patent text and the consultant based them primarily on abstracts (and browsing through the full text when needed). The decisions were then compared and differences discussed. A weakness of this approach is that some examined patent abstracts were not very informative (in spite of the requirement that abstracts should summarize the invention), but our discussions alleviated this.

Analogous limitation and the analogous approach to alleviate it occurred in classifying the analyzed patents according to the application areas (cf. Subsection III.C) and according to the emphasis on ease of operation (cf. Subsection III.F).

Another important limitation is that the number of the studied patents is small – only 23 patents. The primary causes of the low number of studied patents is that we considered only patents from researchers associated with the BDIM workshops and that we used a somewhat restrictive “close to BDIM” criterion to select the patents analyzed in detail. The low number and somewhat limited diversity of the analyzed patents prevents making stronger conclusions (our insights are mainly “indications”) and maybe from identifying some additional trends and relationships. For example, we noticed that only 4 out of 23 analyzed BDIM-related patents sufficiently support ease of operation. It is possible that there are additional BDIM-related patents by other inventors not associated with the BDIM workshop (e.g., also working with IBM and HP, but in advanced development instead of research), with stronger support for ease of operation. However, such limitations of scope can be addressed in subsequent patent surveys.

The readers should remember that patent applications are in most cases published only 18 months after the filing date. Thus, it is likely that there are relevant patent applications that our search did not find because they are not yet made public. Similarly, the pending patent applications will experience change over time – granting/rejection, but possibly also revisions (e.g., due to patent examiner comments). This will alter the insights we got, so we plan subsequent patent surveys.

V. CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

Patents (granted patents and pending applications) are public documents that contain important technical and scientific information that is often not published in academic literature. Unfortunately, many academic researchers in information and communications technologies (ICT) are not aware of how this body of knowledge relates to their own research. Academic ICT literature surveys rarely include patents. Specialized patent surveys (common in biomedical and some other scientific disciplines) are very rarely published in ICT (some patent surveys are conducted in companies and kept private due to their value). Prior to this paper, not only that there was no public patent survey of the BDIM area, but in 4 years of BDIM workshop proceedings [3], [4], [5], [6], including 2 respected literature reviews [1], [2], not a single patent was referenced.

This paper provides an initial IP landscaping survey of the BDIM area. It is based on examination of 23 BDIM-related patents from key potential patent inventors – the researchers associated with the annual BDIM workshops. We used analysis of patents by previously unconsidered co-inventors as well as study of patents that are cited or cite the analyzed BDIM-related patents to discover 7 additional BDIM-related patents. The identification of these 30 (i.e., 23+7) BDIM-related patents is an important contribution of this paper. The newly found patents can be analyzed further to discover additional patents (and maybe new insights). Our citation analysis also showed that some BDIM-related patents are cited multiple times by other patents, probably due to their importance.

Further, we identified the most prolific inventors (both those from the BDIM workshops and their additional co-inventors) and all assignees (only IBM and HP, with no independent academic inventors). We identified the most common among the many used IPC and USPC classifications. We enriched this with our own classification by application area, which identified resource allocation and contract management as the most common application areas. This information about key inventors, assignees, and official patent classifications can be used in further patent searches, e.g., in combination with appropriate keywords. This helps researchers to complement their academic literature surveys with prior art searches of patents, leading to better understanding of the state of the art, research trends, and “white spaces” open for further research.

In particular, we identified that improvement of ease of operation could be a domain of useful further research and patenting, because it is important for market growth of BDIM products but not sufficiently addressed in patents (and, we believe, academic literature). Our year-by-year analysis indicated some growth in interest in BDIM-related innovation.

We acknowledge limitations of this study, but they can be improved in future work. For example, subsequent patent surveys could broaden analysis scope to patents invented by all researchers whose papers were referenced in BDIM workshop proceedings (or at least in the 2 key surveys [1], [2]). A comparison of topics of academic papers and patents in the BDIM area could reveal differences between academia and industry.

An additional contribution of this paper is that it describes techniques for patent search and analysis appropriate for BDIM, but also many other ICT areas where the “terminological mess” limits usefulness of keyword-based searches. These techniques can be practiced by other researchers in subsequent patent surveys of BDIM, but also other areas.

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