

## A Short Talk on Digital Collaboration Topic Based on Bibliometric Data. 2015-2019

### Definitions:

**Digital collaboration** is using [digital technologies](#) for [collaboration](#). Dramatically different from traditional collaboration, it connects a broader network of participants who can accomplish much more than they would on their own.

[https://en.wikipedia.org/wiki/Digital\\_collaboration](https://en.wikipedia.org/wiki/Digital_collaboration)

We define digital collaboration as the process of finding and sharing information. Furthermore, by using technology to our advantage, we are able to use resources to discover, produce and market information. Technology is more than just a means of socializing, and the idea behind digital collaboration is to bring all resources together so that information can be easily shared and ideas can be easily synthesized. [http://honors.journalism.ku.edu/?page\\_id=91](http://honors.journalism.ku.edu/?page_id=91)

### Requests to Scopus:

TITLE-ABS-KEY ( digital AND collaboration ) AND PUBYEAR > 2014 — 4,826 document results

TITLE-ABS-KEY ( digital AND collaboration ) AND PUBYEAR > 2014 AND ( LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "cp" ) ) — 4,029 document results

**Table 1.** Scopus main results values (4,826 documents)

| YEAR | N    | DOCUMENT TYPE     | N    | SOURCE TYPE            | N    | LANGUAGE   | N    |
|------|------|-------------------|------|------------------------|------|------------|------|
| 2020 | 32   | Article           | 2053 | Journals               | 2398 | English    | 4670 |
| 2019 | 1066 | Conference Paper  | 1976 | Conference Proceedings | 1664 | Spanish    | 54   |
| 2018 | 1121 | Book Chapter      | 301  | Book Series            | 481  | Chinese    | 31   |
| 2017 | 983  | Review            | 269  | Books                  | 261  | German     | 22   |
| 2016 | 813  | Conference Review | 117  | Trade Publications     | 22   | French     | 20   |
| 2015 | 811  | Book              | 53   |                        |      | Italian    | 19   |
|      |      | Note              | 17   |                        |      | Portuguese | 9    |
|      |      | Editorial         | 8    |                        |      | Russian    | 7    |
|      |      | Short Survey      | 7    |                        |      | Hungarian  | 2    |
|      |      | Letter            | 4    |                        |      | Japanese   | 2    |
|      |      | Data Paper        | 1    |                        |      | Turkish    | 2    |
|      |      | Undefined         | 20   |                        |      |            |      |

**Remark:** N — means the number of publications; data obtained from file: Scopus\_exported\_refine\_values.csv; interest in the topic is stable, no significant growth is observed; the number of articles and conference papers are comparable.

**Table 2.** Top 30 affiliations, funding sponsors and countries

| AFFILIATION                                       | N  | FUNDING SPONSOR                                    | N  | COUNTRY        | N    |
|---|----|--|----|----------------|------|
| European Organization for Nuclear Research        | 50 | National Science Foundation                        | 75 | United States  | 1283 |
| UCL   | 49 | National Natural Science Foundation of China       | 66 | United Kingdom | 587  |
| CNRS Centre National de la Recherche Scientifique | 45 | European Commission                                | 60 | Germany        | 407  |
| Nanyang Technological University                  | 36 | Engineering and Physical Sciences Research Council | 28 | Italy          | 346  |
| Imperial College London                           | 33 | Australian Research Council                        | 24 | Australia      | 266  |
| Politecnico di Milano                             | 33 | U.S. Department of Energy                          | 24 | China          | 230  |
| Universitetet i Oslo                              | 32 | Bundesministerium für Bildung und Forschung        | 22 | Spain          | 213  |
| Stanford University                               | 30 | National Institutes of Health                      | 22 | Canada         | 208  |
| Helsingin Yliopisto                               | 29 | European Regional Development Fund                 | 20 | France         | 204  |

| AFFILIATION                                    | N  | FUNDING SPONSOR   | N  | COUNTRY            | N   |
|--|----|---|----|--------------------|-----|
| University of Oxford                           | 29 | Conselho Nacional de Desenvolvimento Científico e Tecnológico       | 18 | Netherlands        | 158 |
| Aalborg Universitet                            | 28 | Arts and Humanities Research Council                                | 17 | Switzerland        | 157 |
| University of California, Berkeley             | 27 | Seventh Framework Programme   | 17 | India              | 143 |
| University of Melbourne                        | 27 | Deutsche Forschungsgemeinschaft                                     | 16 | Sweden             | 136 |
| Arizona State University                       | 26 | National Research Foundation of Korea                               | 16 | Finland            | 114 |
| University of Toronto                          | 26 | European Research Council   | 15 | Denmark            | 105 |
| The University of Sydney                       | 26 | Science and Technology Facilities Council                           | 14 | Brazil             | 97  |
| University of Michigan, Ann Arbor              | 26 | Fundação para a Ciência e a Tecnologia                              | 13 | Norway             | 97  |
| University of Illinois at Urbana-Champaign     | 25 | Fundamental Research Funds for the Central Universities             | 12 | Japan              | 86  |
| University of Arizona                          | 25 | National Aeronautics and Space Administration                       | 12 | South Korea        | 81  |
| Pennsylvania State University                  | 24 | National Institute for Health Research                              | 12 | Belgium            | 75  |
| Delft University of Technology                 | 24 | National Sleep Foundation   | 12 | Greece             | 70  |
| Norges Teknisk-Naturvitenskapelige Universitet | 24 | City, University of London  | 11 | Russian Federation | 69  |
| University of Cambridge                        | 24 | Lee Kong Chian School of Medicine, Nanyang Technological University | 11 | Austria            | 66  |
| Chinese Academy of Sciences                    | 23 | National Basic Research Program of China (973 Program)              | 11 | Portugal           | 66  |
| University of Technology Sydney                | 23 | Research and Development  | 11 | South Africa       | 58  |
| University of Pennsylvania                     | 22 | Andrew W. Mellon Foundation   | 10 | Malaysia           | 57  |
| Politecnico di Torino                          | 22 | Coordenação de Aperfeiçoamento de Pessoal de Nível Superior         | 10 | Indonesia          | 56  |
| Indiana University                             | 22 | Social Sciences and Humanities Research Council of Canada           | 10 | Ireland            | 53  |
| Ludwig-Maximilians-Universität München         | 22 | Agence Nationale de la Recherche                                    | 9  | Taiwan             | 53  |
| Lee Kong Chian School of Medicine              | 22 | Economic and Social Research Council                                | 9  | Singapore          | 52  |

**Remark:** the topic is more supported by Europe and North America than China; the issue more concern human and management than technology

**Table 3.** Source titles and keywords related to the digital collaboration topic

| SOURCE TITLE   |     | KEYWORD                           |     |
|--|-----|-----------------------------------|-----|
| Lecture Notes In <b>Computer Science</b> Including Subseries Lecture Notes In <b>Artificial Intelligence</b> And Lecture Notes In Bioinformatics | 171 | Digital Storage                   | 607 |
| ACM International Conference Proceeding Series   | 140 | Collaboration                     | 478 |
| Ceur Workshop Proceedings  | 71  | <b>Human</b>                      | 402 |
| Advances In <b>Intelligent Systems And Computing</b>   | 59  | Education                         | 263 |
| Communications In <b>Computer And Information Science</b>  | 46  | <b>Humans</b>                     | 260 |
| Cochrane Database Of Systematic Reviews  | 45  | <b>Students</b>                   | 241 |
| Journal Of Physics Conference Series   | 45  | Information <b>Management</b>     | 240 |
| IFIP Advances In <b>Information And Communication</b> Technology   | 41  | <b>E-learning</b>                 | 227 |
| Journal Of Medical Internet Research   | 40  | Article                           | 193 |
| Conference On Human Factors In <b>Computing Systems</b> Proceedings  | 38  | Teaching                          | 189 |
| International Archives Of The Photogrammetry Remote Sensing And Spatial <b>Information Sciences</b> ISPRS Archives                               | 28  | <b>Human</b> Computer Interaction | 175 |
| Computer Supported Collaborative Learning Conference Csl   | 26  | Distributed Computer Systems      | 148 |
| Journal Of Instrumentation   | 26  | Priority Journal                  | 145 |
| Proceedings Of SPIE The International Society For Optical Engineering  | 24  | Virtual Reality                   | 142 |

| SOURCE TITLE  |    | KEYWORD                     |     |
|---|----|-----------------------------|-----|
| Proceedings Of Science  | 22 | Architectural Design        | 140 |
| Procedia Manufacturing  | 18 | <b>Decision Making</b>      | 139 |
| <b>Computers And Education</b>  | 17 | Digital Devices             | 139 |
| IEEE Access   | 17 | Design                      | 138 |
| ISPRS Annals Of The Photogrammetry Remote Sensing And Spatial <b>Information Sciences</b> | 17 | Big Data                    | 126 |
| Lecture Notes In Business <b>Information Processing</b>                                   | 17 | Digital Technologies        | 125 |
| ASEE Annual Conference And Exposition Conference Proceedings                              | 16 | Digital Libraries           | 124 |
| Procedia CIRP   | 16 | Procedures                  | 124 |
| AIAA IEEE Digital Avionics Systems Conference Proceedings                                 | 15 | Social Networking (online)  | 124 |
| <b>Digital Library</b> Perspectives   | 15 | Information Systems         | 123 |
| Proceedings Of The ACM IEEE Joint Conference On <b>Digital Libraries</b>                  | 15 | <b>Female</b>               | 113 |
| Proceedings Of The International Astronautical Congress Iac                               | 15 | Engineering Education       | 112 |
| Studies In Health Technology And <b>Informatics</b>                                       | 15 | Knowledge <b>Management</b> | 107 |
| Procedia Computer Science   | 14 | Artificial Intelligence     | 105 |
| Proceedings Of The European Conference On E Learning Ecel                                 | 14 | Data Handling               | 105 |
| Springer Series On <b>Cultural Computing</b>  | 14 | <b>Digital Humanities</b>   | 104 |

**Remark:** publication sources are largely related to — computers, information, communications, intelligent systems, digital libraries and education; from keywords we can build the collaboration chain: humans — management — decision making by digital storage — education and teaching — big data — digital technologies — digital libraries — social networking — artificial intelligence

## Using VOSviewer

Type of analysis: KW co-occurrence, 22726 keywords. 1058 meet the threshold 7.

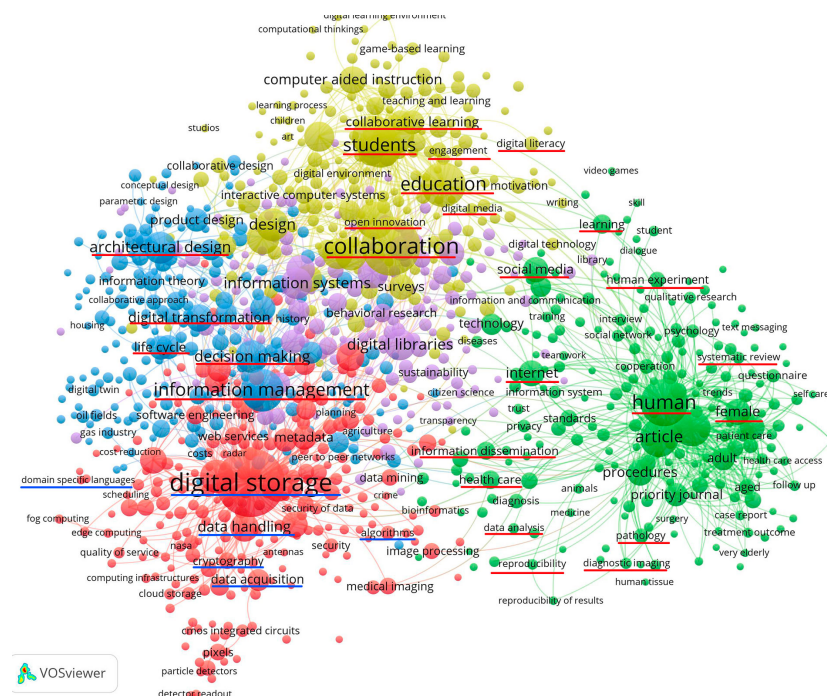
**Table 4.** Top 50 keywords for each of 4 clusters

| label (cl 1)                 | W_L | W_O | label (cl 2)     | W_L | W_O | label (cl 3)                  | W_L | W_O | label (cl 4)               | W_L | W_O |
|------------------------------|-----|-----|------------------|-----|-----|-------------------------------|-----|-----|----------------------------|-----|-----|
| <b>digital storage</b>       | 756 | 580 | <b>human</b>     | 501 | 275 | <b>information management</b> | 567 | 226 | <b>collaboration</b>       | 649 | 423 |
| distributed computer systems | 411 | 139 | article          | 435 | 186 | decision making               | 464 | 131 | education                  | 568 | 247 |
| big data                     | 374 | 116 | humans           | 400 | 168 | architectural design          | 327 | 128 | students                   | 486 | 235 |
| data handling                | 343 | 103 | internet         | 396 | 85  | digital transformation        | 280 | 91  | e-learning                 | 440 | 222 |
| artificial intelligence      | 384 | 99  | female           | 291 | 82  | visualization                 | 266 | 80  | teaching                   | 427 | 180 |
| internet of things           | 279 | 87  | procedures       | 341 | 82  | manufacture                   | 265 | 72  | human computer interaction | 417 | 169 |
| cloud computing              | 341 | 82  | social media     | 212 | 81  | life cycle                    | 268 | 70  | design                     | 392 | 133 |
| metadata                     | 305 | 73  | male             | 274 | 74  | product design                | 220 | 67  | virtual reality            | 380 | 131 |
| interoperability             | 289 | 66  | priority journal | 275 | 69  | data visualization            | 255 | 61  | digital devices            | 410 | 126 |
| semantics                    | 256 | 66  | adult            | 262 | 65  | sustainable development       | 296 | 61  | information systems        | 361 | 120 |

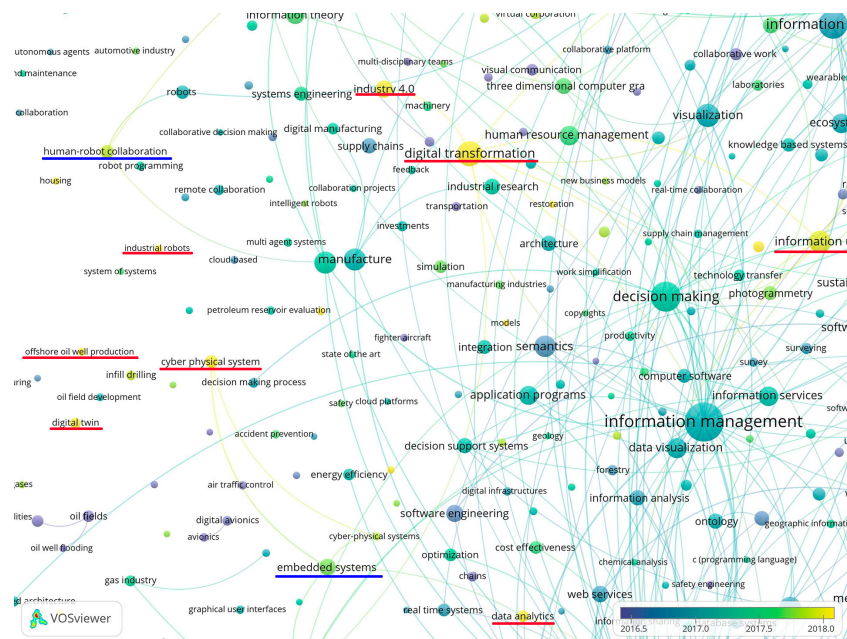
| label (cl 1)                 | W_L | W_O | label (cl 2)                | W_L | W_O | label (cl 3)                        | W_L | W_O | label (cl 4)               | W_L | W_O |
|------------------------------|-----|-----|-----------------------------|-----|-----|-------------------------------------|-----|-----|----------------------------|-----|-----|
| data acquisition             | 223 | 60  | technology                  | 237 | 56  | project management                  | 230 | 58  | digital libraries          | 286 | 119 |
| application programs         | 255 | 54  | communication               | 261 | 52  | human resource management           | 242 | 56  | social networking (online) | 372 | 118 |
| software design              | 218 | 53  | learning                    | 199 | 47  | automation                          | 291 | 55  | digital technologies       | 354 | 116 |
| websites                     | 205 | 50  | health care                 | 257 | 43  | information theory                  | 207 | 49  | engineering education      | 329 | 113 |
| high energy physics          | 104 | 43  | information dissemination   | 285 | 41  | industry 4.0                        | 179 | 44  | knowledge management       | 330 | 103 |
| software engineering         | 171 | 43  | software                    | 230 | 35  | building information modelling      | 156 | 43  | computer aided instruction | 262 | 92  |
| web services                 | 206 | 40  | standards                   | 213 | 35  | embedded systems                    | 178 | 42  | learning systems           | 323 | 91  |
| analog to digital conversion | 181 | 39  | middle aged                 | 178 | 34  | three dimensional computer graphics | 172 | 39  | surveys                    | 354 | 81  |
| network architecture         | 157 | 39  | organization and management | 211 | 33  | cultural heritages                  | 135 | 38  | curricula                  | 282 | 80  |
| international cooperation    | 222 | 37  | aged                        | 183 | 32  | building information model - bim    | 165 | 37  | innovation                 | 246 | 80  |
| data mining                  | 179 | 36  | controlled study            | 188 | 32  | interdisciplinary collaborations    | 198 | 37  | digital humanities         | 149 | 79  |
| information analysis         | 194 | 36  | health care delivery        | 193 | 32  | computer aided design               | 150 | 36  | collaborative learning     | 216 | 73  |
| pixels                       | 55  | 36  | human experiment            | 167 | 32  | construction industry               | 139 | 35  | information use            | 278 | 72  |
| cryptography                 | 97  | 35  | quality control             | 206 | 31  | supply chains                       | 179 | 35  | augmented reality          | 223 | 62  |
| computer architecture        | 159 | 34  | telemedicine                | 181 | 31  | architecture                        | 166 | 34  | human engineering          | 198 | 57  |
| medical imaging              | 165 | 34  | cooperation                 | 222 | 28  | decision support systems            | 204 | 34  | user interfaces            | 196 | 57  |
| data privacy                 | 148 | 33  | diagnosis                   | 200 | 28  | bim                                 | 133 | 31  | ecosystems                 | 216 | 57  |
| monitoring                   | 187 | 33  | major clinical study        | 148 | 28  | historic preservation               | 112 | 30  | information services       | 229 | 56  |
| open systems                 | 171 | 33  | pathology                   | 151 | 28  | robotics                            | 144 | 30  | problem solving            | 213 | 55  |
| search engines               | 160 | 32  | mobile applications         | 154 | 27  | digital fabrication                 | 100 | 29  | societies and institutions | 237 | 52  |
| data transfer                | 129 | 31  | clinical article            | 153 | 25  | photogrammetry                      | 101 | 29  | personnel training         | 215 | 47  |
| image processing             | 182 | 31  | cooperative behavior        | 200 | 24  | systems engineering                 | 156 | 29  | behavioral research        | 220 | 45  |
| open source software         | 158 | 31  | psychology                  | 169 | 23  | human-robot collaboration           | 88  | 28  | digitization               | 189 | 43  |
| complex networks             | 179 | 30  | questionnaire               | 160 | 23  | knowledge based systems             | 132 | 28  | ecology                    | 206 | 43  |
| computer software            | 141 | 29  | interpersonal communication | 160 | 22  | robots                              | 98  | 27  | education computing        | 165 | 42  |
| integration                  | 193 | 29  | marketing                   | 118 | 22  | electronic data interchange         | 180 | 26  | higher education           | 127 | 41  |

| label (cl 1)                     | W_L | W_O | label (cl 2)             | W_L | W_O | label (cl 3)           | W_L | W_O | label (cl 4)                        | W_L | W_O |
|----------------------------------|-----|-----|--------------------------|-----|-----|------------------------|-----|-----|-------------------------------------|-----|-----|
| readout systems                  | 47  | 29  | mobile application       | 131 | 21  | cost effectiveness     | 159 | 25  | interactive computer systems        | 156 | 41  |
| ubiquitous computing             | 140 | 29  | information processing   | 173 | 20  | cyber physical system  | 117 | 25  | commerce                            | 190 | 41  |
| access control                   | 85  | 28  | information system       | 169 | 20  | history                | 99  | 25  | smart city                          | 170 | 41  |
| middleware                       | 126 | 28  | privacy                  | 141 | 20  | real time systems      | 142 | 25  | creativity                          | 122 | 40  |
| blockchain                       | 99  | 27  | united states            | 153 | 20  | risk assessment        | 138 | 25  | libraries                           | 149 | 39  |
| electronic document exchange     | 148 | 27  | data sharing             | 122 | 19  | simulation             | 119 | 25  | computer games                      | 134 | 38  |
| machine learning                 | 134 | 27  | diseases                 | 136 | 19  | cultural heritage      | 94  | 24  | mobile devices                      | 167 | 37  |
| mobile telecommunication systems | 139 | 27  | documentation            | 107 | 19  | information technology | 141 | 24  | industrial research                 | 193 | 37  |
| network security                 | 121 | 27  | electronic health record | 128 | 19  | optimization           | 108 | 24  | ontology                            | 158 | 36  |
| security                         | 110 | 26  | interview                | 154 | 19  | remote sensing         | 147 | 24  | computer programming                | 112 | 35  |
| algorithms                       | 154 | 25  | medical education        | 114 | 19  | climate change         | 113 | 23  | economics                           | 187 | 34  |
| signal processing                | 113 | 25  | medical informatics      | 148 | 19  | construction           | 121 | 23  | computer supported cooperative work | 138 | 33  |
| internet of things (iot)         | 143 | 24  | outcome assessment       | 109 | 19  | health                 | 137 | 23  | interactive computer graphics       | 127 | 33  |
| hardware                         | 111 | 23  | systematic review        | 91  | 19  | 3d printers            | 127 | 22  | motivation                          | 163 | 33  |

**Remark:** the results are in good agreement with the table 3.



**Figure 1.** Keyword clustering by co-occurrence in documents, (22726 keywords. 1058 meet the threshold 7)  
[Scopus\\_all\\_years\\_KW\\_co-occurer.png\(3.24 MB\)](#)



**Figure 2.** keywords layout 2015 – 2019. Emerging topics: industrial robots; cyber physical system; digital twin; digital transformation; data analysis; industry 4.0; offshore oil well production. <https://ndownloader.figshare.com/files/20805603>

**Table 5.** Countries, bibliographic coupling, total 147 countries, 70 meet threshold 5

| country        | documents | citations | total link strength | country            | documents | citations | total link strength |
|----------------|-----------|-----------|---------------------|--------------------|-----------|-----------|---------------------|
| united states  | 1059      | 4558      | 31835               | south africa       | 49        | 111       | 3642                |
| united kingdom | 458       | 2092      | 24742               | austria            | 54        | 132       | 3145                |
| germany        | 358       | 1228      | 15319               | poland             | 30        | 124       | 3019                |
| italy          | 306       | 938       | 12434               | portugal           | 56        | 155       | 2871                |
| spain          | 187       | 596       | 10618               | new zealand        | 35        | 174       | 2846                |
| netherlands    | 130       | 594       | 10538               | turkey             | 40        | 196       | 2294                |
| france         | 177       | 564       | 10537               | taiwan             | 49        | 137       | 2165                |
| australia      | 210       | 750       | 10259               | south korea        | 72        | 209       | 2025                |
| switzerland    | 119       | 387       | 8320                | mexico             | 37        | 97        | 1922                |
| canada         | 170       | 743       | 7190                | ireland            | 43        | 116       | 1907                |
| china          | 207       | 679       | 6635                | chile              | 11        | 25        | 1629                |
| sweden         | 110       | 813       | 6567                | malaysia           | 49        | 123       | 1629                |
| denmark        | 90        | 247       | 5485                | singapore          | 27        | 65        | 1567                |
| finland        | 100       | 237       | 5464                | hong kong          | 24        | 133       | 1414                |
| norway         | 86        | 257       | 5001                | cyprus             | 14        | 26        | 1403                |
| belgium        | 58        | 144       | 4624                | indonesia          | 55        | 70        | 1236                |
| india          | 119       | 199       | 4347                | croatia            | 13        | 91        | 1204                |
| brazil         | 83        | 190       | 4191                | colombia           | 16        | 30        | 1184                |
| japan          | 73        | 347       | 3915                | russian federation | 60        | 82        | 1055                |
| greece         | 56        | 164       | 3893                | saudi arabia       | 21        | 85        | 935                 |

**Remark:** United States — documents/citations/total link strength; 4558/1059 = 4,3; 31835/1059 = 30,06; Russian Federation — 82/60 = 1,36; 1055/80 = 17,58; — low citation and link strength

**Table 6.** Top 30 organizations sorted by total link strength (Organizations, bibliographic coupling, total 8127 organizations, 58 meet threshold 3)

| organization  | documents | citations | total link strength |
|---|-----------|-----------|---------------------|
| university of toronto, canada                             | 8         | 12        | 97                  |
| lias/isae-ensma, poitiers university, chasseneuil, france | 3         | 4         | 94                  |

| organization   | documents | citations | total link strength |
|--|-----------|-----------|---------------------|
| université de lorraine and inria-loria grand est, nancy, france              | 3         | 4         | 94                  |
| stanford university, united states   | 4         | 0         | 77                  |
| new york university, united states   | 3         | 1         | 72                  |
| <b>kuwait oil company, kuwait</b>  | 8         | 4         | 67                  |
| weatherford, united states   | 5         | 8         | 67                  |
| university of rostock, rostock, germany                                      | 4         | 51        | 58                  |
| aalen university, germany  | 3         | 17        | 57                  |
| california state university, long beach, united states                       | 3         | 23        | 56                  |
| prostep ag, germany  | 4         | 15        | 54                  |
| university of michigan, united states  | 5         | 6         | 40                  |
| queensland university of technology, australia                               | 4         | 9         | 39                  |
| cern, geneva, switzerland  | 15        | 35        | 32                  |
| university of texas at austin, united states                                 | 3         | 0         | 27                  |
| university of oslo, oslo, norway   | 3         | 11        | 25                  |
| university of melbourne, australia   | 3         | 4         | 24                  |
| university of minnesota, united states                                       | 3         | 0         | 24                  |
| los alamos national laboratory, los alamos, nm, united states                | 3         | 1         | 20                  |
| sandia national laboratories, albuquerque, nm 87185, united states           | 3         | 2         | 20                  |
| <b>saudi aramco, saudi arabia</b>  | 3         | 2         | 13                  |
| school of education, iowa state university, ames, ia, united states          | 3         | 14        | 12                  |
| <b>schlumberger, united states</b>   | 8         | 4         | 11                  |
| cern, geneva 23, ch-1211, switzerland  | 3         | 3         | 9                   |
| cern, geneva, 1211, switzerland  | 3         | 15        | 9                   |
| university of helsinki, finland  | 3         | 1         | 9                   |
| graduate school of education, university of bristol, bristol, united kingdom | 3         | 19        | 6                   |
| university of arizona, united states   | 3         | 1         | 6                   |
| university of oslo, norway   | 3         | 1         | 6                   |
| arizona state university, united states                                      | 6         | 16        | 5                   |

**Remark:** Universities in Canada, the USA and Europe dominate the list. The presence of two Arab universities and the Schlumberger service company is noteworthy.

**Table 7.** Titles and abstracts of the papers cited more than 3 times (2019)

| Title   | Abstract   | Cited by |
|---|--|----------|
| Making Big Data Open in Edges: A Resource-Efficient Blockchain-Based Approach | The emergence of edge computing has witnessed a fast-growing volume of data on edge devices belonging to different stakeholders which, however, cannot be shared among them due to the lack of the trust. By exploiting blockchain's non-repudiation and non-tampering properties that enable trust, we develop a <b>blockchain-based big data sharing framework</b> to support various applications across resource-limited edges. In particular, we devise a number of novel resource-efficient techniques for the framework: (1) the PoC ( <b>Proof-of-Collaboration</b> ) based <b>consensus mechanism</b> with <b>low computation complexity</b> which is especially beneficial to the edge devices with low computation capacity, (2) the blockchain transaction filtering and offloading scheme that can significantly reduce the storage overhead, and (3) new types of blockchain transaction (i.e., Express Transaction) and block (i.e., Hollow Block) to <b>enhance the communication efficiency</b> . Extensive experiments are conducted and the results demonstrate the superior performance of our proposal. © 1990-2012 IEEE. | 12       |

| Title   | Abstract  | Cited by |
|---|---|----------|
| Improving fog computing performance via Fog-2-Fog collaboration   | In the <b>Internet of Things (IoT)</b> era, a large volume of data is continuously emitted from a plethora of connected devices. The current network paradigm, which relies on centralised data centres (aka <b>Cloud computing</b> ), has become inefficient to respond to IoT latency concern. To address this concern, fog computing allows data processing and storage “close” to IoT devices. However, fog is still not efficient due to spatial and temporal distribution of these devices, which leads to fog nodes’ unbalanced loads. This paper proposes a new <b>Fog-2-Fog (F2F) collaboration</b> model that promotes offloading incoming requests among fog nodes, according to their load and processing capabilities, via a <b>novel load balancing</b> known as <b>Fog Resource manAgeMent Scheme (FRAMES)</b> . A <b>formal mathematical model of F2F</b> and FRAMES has been formulated, and a set of experiments has been carried out demonstrating the technical doability of <b>F2F collaboration</b> . The performance of the proposed <b>fog load balancing model</b> is compared to other load balancing models. © 2019 Elsevier B.V.  | 11       |
| Enhancing students’ motivation to learn computational thinking through mobile application development module (M-CT)   | In the 21st century, making daily innovations in software and hardware to facilitate the life process is the daily task of the community. This innovation also goes beyond the education field, various interventions were introduced by <b>integrating technology to enhance the understanding and motivating of students in a subject</b> . In view of this, we brought modernization into the learning of <b>Computational Thinking (CT)</b> in the form of a module that integrates mobile application development for the motivation of students in CT. In this module, students are taught to develop mobile applications using a <b>visual programming language</b> . This approach can be a catalyst for enhancing the motivation of students of the digital generation and the efficiency of learning. In motivation measurement, we used the <b>Motivated Strategies for Learning Questionnaire (MSLQ)</b> , which consists of five domains of motivation, namely Intrinsic Goal, Extrinsic Goal, Task Value, Learning Beliefs Control and Self-Efficacy. This is divided into two groups, namely conventional and mobile applications for control and treatment groups. In treatment group consisted of 46 (51%) and the control group consisted of 45 (49%) respondents. All respondents of this study are students, studying in Institute A that offers similar courses which are Bachelor of Business Administration degree in collaboration with two different universities (University A and University B). © BEIESP. | 11       |
| The effectiveness of virtual environments in developing collaborative strategies between industrial robots and humans | Testing and implementation of <b>Human-Robot Collaboration (HRC)</b> could be dangerous due to the high-speed movements and massive forces generated by <b>industrial robots</b> . Wherever humans and industrial robots share a <b>common workplace</b> , <b>accidents</b> are likely to happen and always unpredictable. This has hindered the <b>development of human robot collaborative strategies</b> as well as the ability of authorities to pass <b>regulations on how humans and robots should work together</b> in close proximities. This paper presents the use of a <b>Virtual Reality digital twin</b> of a physical layout as a mechanism to understand human reactions to both <b>predictable and unpredictable robot motions</b> . A set of established metrics as well as a newly developed <b>Kinetic Energy Ratio metric</b> are used to analyse human reactions and validate the effectiveness of the Virtual Reality environment. It is the aim that <b>Virtual Reality digital twins</b> could inform the <b>safe implementation of Human-Robot Collaborative strategies</b> in factories of the future. © 2018   | 11       |
| A data replica placement strategy for IoT workflows in collaborative edge and cloud environments                      | The convergence of edge and cloud computing shares their strengths, such as <b>unlimited shared storage</b> and computing resources from cloud, <b>low-latency data preprocessing</b> of edge computing. The <b>collaboration of the two computing paradigms</b> can provide a <b>real-time</b> and <b>cost-effective</b> way to deploy Internet of Things (IoT) workflows among cooperative user groups. Since <b>huge amounts of datasets</b> continuously generated from user devices, how to place them to <b>reduce the data access costs</b> while meeting the deadline constraint is a critical issue. This paper proposed a <b>novel data replica placement strategy</b> for coordinated processing data-intensive IoT workflows in collaborative edge and cloud computing environment. Firstly, data replica placement can be modelled as a 0–1 integer programming problem to consider the overall data dependency, data reliability and user cooperation. And then, the ITÖ algorithm, a variant of <b>intelligent swarm optimization</b> , is presented to address this model. The experimental results show that the proposed method outperforms these compared algorithms. It can not only find a higher quality solution of data replica placement, but also need a lower computing budget compared with these traditional algorithms. © 2018 Elsevier B.V.  | 11       |



| Title  | Abstract   | Cited by |
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| Toward a new generation of smart skins   | Rapid advances in soft electronics, <b>microfabrication technologies</b> , miniaturization and electronic skins are facilitating the development of <b>wearable sensor devices</b> that are highly conformable and intimately associated with <b>human skin</b> . These devices—referred to as ‘ <b>smart skins</b> ’—offer new opportunities in the research study of human biology, in physiological tracking for fitness and wellness applications, and in the examination and treatment of medical conditions. Over the past 12 months, electronic skins have been developed that are self-healing, intrinsically stretchable, designed into an artificial afferent nerve, and even self-powered. Greater <b>collaboration between engineers, biologists, informaticians and clinicians will be required for smart skins</b> to realize their full potential and attain wide adoption in a diverse range of real-world settings. © 2019, Springer Nature America, Inc.   | 10       |
| Public auditing for shared cloud data with efficient and secure group management   | With increasing popularity of <b>collaboration in clouds</b> , shared data auditing has become an important issue in cloud auditing field, and attracted extensive attention from the research community. However, none of the state of the arts can fully achieve all indispensable functional and <b>security requirements</b> . Thus, in this paper, we present a comprehensive <b>public auditing scheme for shared data</b> . Specifically, to <b>preserve users’ identity privacy</b> , signatures on the challenged blocks are converted to the ones signed by the group manager during proof generation; to protect data privacy, a <b>random masking</b> is adopted to <b>blind data proof</b> ; a modification record table is designed to record operation information to support identity traceability; we further extend the dynamic hash table to support shared-data dynamics, and present a batch auditing strategy. Moreover, we design a lazy-revocation based <b>group management mechanism</b> to achieve efficient group dynamics, which can <b>resist collusion attacks</b> while significantly reducing computational costs. We formally prove the security of our scheme, and evaluate its performance by comprehensive experiments and comparisons with the state-of-the-art ones. The results demonstrate that our scheme can effectively achieve secure auditing and outperforms the previous ones in computational overhead while maintaining relatively low communication costs. © 2018 Elsevier Inc. | 9        |
| Dialogue, thinking together and digital technology in the classroom: Some educational implications of a continuing line of inquiry | This article describes a continuing programme of school-based applied research. The basis of this research, which originated in a project called ‘Thinking Together’, lies in the relationship between language and cognitive development postulated by sociocultural theory. The research has developed and tested methods for improving the quality of classroom interaction amongst teachers and students, looking for improved levels of collaboration, reasoning, and academic attainment as the desirable outcomes. A key strand of this research concerns the use of digital technology for supporting classroom dialogue and students’ emerging thinking over time. As we will explain, the outcomes of several research projects pursuing this line of enquiry have yielded positive results which have direct implications for classroom pedagogy and practice. © 2017   | 9        |
| The global impact of science gateways, virtual research environments and virtual laboratories                                      | Science gateways, virtual laboratories and virtual research environments are all terms used to refer to community-developed digital environments that are designed to meet a set of needs for a research community. Specifically, they refer to <b>integrated access to research community resources</b> including software, data, <b>collaboration tools</b> , workflows, instrumentation and <b>high-performance computing</b> , usually via Web and mobile applications. Science gateways, <b>virtual laboratories</b> and virtual research environments are enabling significant contributions to many research domains, facilitating more efficient, open, reproducible research in bold new ways. This paper explores the global impact achieved by the sum effects of these programs in increasing research impact, demonstrates their value in the broader digital landscape and discusses future opportunities. This is evidenced through examination of national and international programs in this field. © 2019 Elsevier B.V.  | 7        |

| Title  | Abstract   | Cited by |
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| Industry 4.0 and capability development in manufacturing subsidiaries  | <p>This paper investigates whether advanced manufacturing technologies (AMT) can modify the <b>patterns of upgrading in manufacturing subsidiaries operating</b> in FDI hosting factory economies. Does the <b>digital transformation of local manufacturing</b> engender the accumulation of local technological and R&amp;D capabilities, or the beneficial impact of AMT remains confined to production capability? Analysis is based on primary data collected through in-depth interviews with a sample of high-flying manufacturing subsidiaries in Hungary, complemented with interviews with AMT providers. We find that AMT have spectacularly improved all components of production capability. AMT redefined the boundaries of production activities and incited a fusion of selected technological activities in production activities. AMT deployment has automated selected tacit knowledge-intensive technological activities, making the related subsidiary-level capabilities obsolete. Conversely, other local technological activities have become more knowledge-intensive than before. AMT propelled the upgrading of subsidiary-level R&amp;D capabilities by supporting specific R&amp;D activities and by acting as enabler of innovation collaboration. AMT created an <b>integrated development environment</b> and thus <b>reduced the risks related to the decentralisation of R&amp;D</b>. Altogether, AMT adoption contributed to subsidiary R&amp;D capability becoming ‘revealed’ and further upgraded through learning by doing. © 2018 Elsevier Inc.</p>   | 6        |
| The emergence of the maker movement: Implications for entrepreneurship research  | <p>The maker movement has been touted as a harbinger of the next industrial revolution. Through <b>shared access to tools and digital fabrication technologies</b>, makers can act as producers in the <b>sharing economy</b> and potentially increase entrepreneurship rates, catalyze advanced manufacturing, and spur economic development. We develop a <b>model of the maker movement</b> configured around social exchange, technology resources, and <b>knowledge creation and sharing</b>. We highlight opportunities for studying the conditions under which the movement might foster entrepreneurship outcomes and discuss how research on <b>the maker movement</b> can deepen our <b>understanding of entrepreneurial teams</b> and corporate entrepreneurship. © 2019 Elsevier Inc.</p>  | 6        |
| ESC e-Cardiology Working Group Position Paper: Overcoming challenges in digital health implementation in cardiovascular medicine | <p><b>Cardiovascular disease</b> is one of the main causes of morbidity and mortality worldwide. Despite the availability of highly effective treatments, the contemporary burden of disease remains huge. Digital health interventions hold promise to improve further <b>the quality and experience of cardiovascular care</b>. This position paper provides a brief overview of currently existing digital health applications in different cardiovascular disease settings. It provides the reader with the most relevant challenges for their large-scale deployment in Europe. The potential role of different stakeholders and related challenges are identified, and the key points suggestions on how to proceed are given. This position paper was developed by the European Society of Cardiology (ESC) e-Cardiology working group, in close <b>collaboration with the ESC Digital Health Committee</b>, the European Association of Preventive Cardiology, the European Heart Rhythm Association, the Heart Failure Association, the European Association of Cardiovascular Imaging, the Acute Cardiovascular Care Association, the European Association of Percutaneous Cardiovascular Interventions, the Association of Cardiovascular Nursing and Allied Professions and the Council on Hypertension. It relates to the ESC's action plan and mission to play a pro-active role in all aspects of the e-health agenda in support of cardiovascular health in Europe and aims to be used as <b>guiding document for cardiologists</b> and other relevant stakeholders in the field of digital health. © The European Society of Cardiology 2019.</p> | 5        |

| Title  | Abstract  | Cited by |
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| Audience-centric engagement, collaboration culture and platform counterbalancing: A longitudinal study of ongoing sensemaking of emerging technologies   | <b>Digital journalism</b> studies have done little in terms of studying longitudinally the interrelationships between emerging technology and convergent news practices. This study addresses that void by using a <b>sensemaking approach</b> to examine how <b>emerging technology</b> was appropriated and enacted in the convergent news activities of newswriters, and how they made sense of the emerging technologies over two and a half years. Our study analyzes two newsrooms in Singapore: 1) a digital-first legacy newspaper, and 2) an <b>independent digital-only news</b> startup. This article employs the Infotendencias Group's (2012) analytical framework and its four dimensions of news convergence: i) business, ii) professional, iii) technological, and iv) contents. Additionally, it proposes and employs a fifth dimension: v) <b>audience-centric engagement</b> . The fifth dimension is based on the <b>concept of "measurable journalism"</b> (Carlson, 2018), analyzing how its actors influence the relationship between newsrooms and their audiences. This study builds on two rounds of <b>in-depth interviews</b> conducted from end-2015 to mid-2016, and again in 2018. Our findings show that <b>audience-centric-engagement practices</b> are observed in all four dimensions of convergent news activities of each news organization, and leads to three main conclusions: 1) the growing significance of audience-centric engagement, 2) an emergence of a <b>collaboration culture</b> , and 3) the salience of platform counterbalancing. © 2019 by the authors; tion. | 5        |
| Analysis of the digital teaching competence: Key factor in the performance of active pedagogies with augmented reality [Análisis de la competencia digital docente: Factor clave en el desempeño de pedagogías activas con realidad aumentada] | In a time conditioned by continuous technological advances, it is essential to <b>train teachers in digital competence</b> in order to respond to the needs and concerns of students. The educational processes of the teacher acquire great relevance to have the required skills against the use of new emerging resources. This study focuses on knowing the digital teaching competence in the development and application of <b>augmented reality resources</b> . A non-experimental design of descriptive and correlational type has been followed through a quantitative method. Two questionnaires were used, applied to a sample of 2631 teachers. The results obtained reveal that the teaching staff carries out continuous training, carrying out 2-3 courses per year related to ICT and other areas, in person. They demonstrate skills in certain areas of digital teaching competence, such as security and communication and collaboration, as well as a deficit in the creation of digital content. Deepening in the areas more analogous to augmented reality, according to the type of center and educational stage, it is the public and primary education centers that have revealed the highest level of competence. © 2019 Revista Iberoamericana Sobre Calidad, Eficacia y Cambio en Educacion. All rights reserved.   | 5        |
| The agency of patients and carers in medical care and self-care technologies for interacting with doctors  | People living with <b>Parkinson's disease</b> engage in self-care for most of the time but, two or three times a year, they meet with doctors to re-evaluate the condition and adjust treatment. Patients and (informal) carers participate actively in these encounters, but their engagement might change as new <b>patient-centred technologies</b> are <b>integrated into healthcare infrastructures</b> . Drawing on a qualitative study that used observations and interviews to investigate consultations, and digital ethnography to understand interactions in an online community, we describe how <b>patients and carers living with Parkinson's participate in the diagnosis and treatment decisions</b> , engage in discussions to learn about certain topics, and address inappropriate medication. We contrast their engagement with a review of <b>self-care technologies</b> that support interactions with doctors, to investigate how these artefacts may influence the agency of patients and carers. Finally, we discuss design ideas for <b>improving the participation of patients and carers in technology-mediated scenarios</b> . © The Author(s) 2017.   | 4        |
| The interactivity of video and collaboration for learning achievement, intrinsic motivation, cognitive load, and behavior patterns in a digital game-based learning environment  | This study investigated how the use of an <b>instructional video and collaboration influenced the learning achievement</b> , intrinsic motivation, cognitive load, and learning behaviors of students learning Newtonian mechanics within a digital game-based learning (DGBL) environment. The participants were 109 seventh-grade students who were randomly assigned to one of four experimental groups, forming a 2 × 2 factorial design, with the presence or absence of an instructional video as one factor and collaboration as the other. With regard to learning achievement, the findings revealed <b>a significant main interaction effect between the use of an instructional video and collaboration</b> . While collaborative DGBL promoted intrinsic motivation, the results for cognitive load showed that the use of an instructional video in collaborative DGBL significantly reduced both intrinsic and extraneous cognitive loads. The implications for designing game-based science learning are discussed. © 2019   | 4        |

| Title   | Abstract  | Cited by |
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| A novel EMR integrity management based on a medical blockchain platform in hospital                       | Recent advancements in information and communication technology is enabling a significant revolution in e-Health research and industry. In the case of <b>personal medical data sharing, data security and convenience</b> are crucial requirements to the interaction and collaboration of electronic medical record (EMR) systems. However, it's hard for current systems to meet these requirements as they have inconsistent structures in terms of security policies and access control models. A new solution direction is essential to <b>enhance data-accessing</b> while <b>regulating it with government mandates</b> in privacy and security to ensure the accountability of the medical usage data. Blockchain seems to pave the way for revolution in the conventional healthcare industry benefiting by its unique features such as data privacy and transparency. In this paper, a blockchain-based medical platform using a smart contract is proposed to secure the EMR management. This approach provides patients a comprehensive, immutable log and easy access to their medical information across different departments within the hospital. A case study for <b>hospital is built on a permissioned network</b> , and a series of experimental tests are performed to demonstrate the usability and efficiency of the designed platform. Lastly, a benchmark study by leveraging various performance metrics is made and the outcomes indicate that the designed platform surpasses the ability of existing works in various aspects. The results of this work reveal that the proposed solution has the great potential to accelerate the development of a <b>decentralized digital healthcare ecosystem</b> . © 2019 by the authors. Licensee MDPI, Basel, Switzerland.  | 4        |
| Participation through place-based e-tools: A valuable resource for urban green infrastructure governance? | <b>Digital communication tools for information sharing</b> are being increasingly used in governance, including green space governance and natural resource management and planning. Citizens' resources in the form of knowledge, skills, as well as their collaboration with authorities have been identified in the <b>governance literature as crucial elements in sustainable development</b> . Technical advancement in internet communication technology (ICT) presents novel opportunities for engaging and leveraging civic knowledge and skills into different levels of governance. These options are still largely unexplored in governance research on urban green infrastructure (UGI). In this paper, we analyse three different digital tools (e-tools) from the perspective of a Scandinavian planning context. We explore how e-tools can support UGI governance and the perceived barriers. The e-tools explored are three digital platforms with a focus on public participation related to UGI. The three e-tools are map-based, i.e., users share information on digital maps: so-called Volunteered Geographic Information. Here, we call them place-based e-tools. We explore and analyse their adoption into UGI governance, the institutional contexts that affect them and also discuss potential of e-tools in place-based governance. Our findings indicate that the analysed tools all facilitate UGI governance in terms of engaging citizens in use, management, and planning of UGI. However, there are challenges to be aware of, such as the digital divide and the importance of clear participatory frameworks. We conclude that place-based e-tools have potential for UGI governance and that there is potential to strengthen links to 'place', while continuously testing and challenging new opportunities as technology rapidly develops. © 2018 Elsevier GmbH | 4        |
| Computational Thinking Equity in Elementary Classrooms: What Third-Grade Students Know and Can Do         | The <b>Computer Science Teachers Association</b> has asserted that computational thinking equips students with essential critical thinking which allows them to conceptualize, analyze, and solve more complex problems. These skills are applicable to all content area as students learn to use strategies, ideas, and technological practices more effectively as digital natives. This research examined over 200 elementary students' pre- and posttest changes in computational thinking from a 10-week coding program using adapted lessons from code.org's Blockly programming language and CSUnplugged that were delivered as part of the regular school day. Participants benefited from <b>early access to computer science (CS) lessons</b> with increases in computational thinking and applying coding concepts to the real world. Interviews from participants included examples of CS connections to everyday life and interdisciplinary studies at school. Thus, the study highlights the importance of leveraging CS access in diverse elementary classrooms to promote young students' computational thinking; motivation in CS topics; and the learning of essential soft-skills such as collaboration, persistence, abstraction, and creativity to succeed in today's digital world. © The Author(s) 2018.   | 4        |

| Title  | Abstract   | Cited by |
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| Digital storytelling and audience engagement in cultural heritage management: A collaborative model based on the Digital City of Thessaloniki                      | Cities are complex, networked and continuously changing social ecosystems, shaped and transformed through the interaction of different interests and ambitions. They are linked to places, where various aspects of past events are projected and expressed by means of personal memories and narrations (urban memory), representing a promise for future: a vision of freedom, creativity, opportunity and prosperity. At the same time, technology is currently promoting unprecedented changes in urban areas, which are often marked as smart city developments. This paper studies the history of cultural and creative industries, bringing forward the dedicated digital storytelling strategies that promote active audience engagement in urban cultural heritage. <b>A collaborative model</b> is proposed and analyzed (in multiple perspectives), aiming at providing an integrated manner for heritage documentation, management and dissemination. The development deals with the Digital City of Thessaloniki, Greece, a big city, not a boundless one, rich in culture, but with rather poor heritage management mechanisms. The research focuses on theoretical and practical aspects for the citizens' collection and interpretation of <b>"digital heritage"</b> documents (artifacts, places, etc.), resulting in a model that fuels audience engagement and <b>collaboration of cultural organizations</b> . Model-design is validated through state-of-the-art review and formative evaluation processes (both qualitative and quantitative), with an associated SWOT analysis that points out strengths, weaknesses, opportunities and threats. Although the proposed methodology has been adapted to the needs of a particular (digital) city, the current paper goes beyond a case study, as it brings forward <b>novel technological and methodological guidelines</b> , which could be successfully deployed in districts with similar cultural, geographical, and technical features. © 2018  | 4        |
| Fog data analytics: A taxonomy and process model   | Through the <b>exponential growth of sensors</b> and smart gadgets (collectively referred to as smart devices or Internet of Things (IoT) devices), significant amount of heterogeneous and multi-modal data, termed as Big Data (BD), is being generated. To deal with such BD, we require efficient and effective solutions such as data mining, analytics, and reduction to be deployed at the edge of fog devices on a cloud. Existing research and development efforts generally focus on performing <b>BD analytics</b> overlook the difficulty of facilitating fog data analytics (FDA). In this paper, we discuss the unique nature and complexity of fog data analytics. A detailed taxonomy for FDA is abstracted into a process model. The proposed model addresses various research challenges, such as accessibility, scalability, fog nodes communication, <b>nodal collaboration</b> , heterogeneity, reliability, and quality of service (QoS) requirements. To demonstrate the proposed process model, we present two case studies. © 2018 Elsevier Ltd   | 4        |
| Influences on the implementation of mobile learning for medical and nursing education: Qualitative systematic review by the digital health education collaboration | Background: In the past 5 decades, <b>digital education</b> has increasingly been used in health professional education. <b>Mobile learning (mLearning)</b> , an emerging form of educational technology using mobile devices, has been used to supplement learning outcomes through enabling conversations, sharing information and knowledge with other learners, and aiding support from peers and instructors regardless of geographic distance. Objective: This review aimed to synthesize findings from qualitative or mixed-methods studies to provide insight into factors facilitating or hindering implementation of mLearning strategies for medical and nursing education. Methods: A systematic search was conducted across a range of databases. Studies with the following criteria were selected: examined <b>mLearning</b> in medical and nursing education, employed a mixed-methods or qualitative approach, and published in English after 1994. Findings were synthesized using a framework approach. Results: A total of 1946 citations were screened, resulting in 47 studies being selected for inclusion. Most studies evaluated pilot mLearning interventions. The synthesis identified views on valued aspects of mobile devices in terms of efficiency and personalization but concerns over vigilance and poor device functionality; emphasis on the social aspects of technology, especially in a clinical setting; the value of interaction learning for clinical practice; mLearning as a process, including learning how to use a device; and the importance of institutional infrastructure and policies. Conclusions: The portability of mobile devices can enable interactions between learners and educational material, fellow learners, and educators in the health professions. However, devices need to be incorporated institutionally, and learners and educators need additional support to fully comprehend device or app functions. The strategic support of mLearning is likely to require procedural guidance for practice settings and device training and maintenance services on campus. ©Priya Lall, Rebecca Rees, Gloria Chun Yi Law, Gerard Dunleavy, Živa Cotič, Josip Car. | 4        |

| Title   | Abstract  | Cited by |
|---|---|----------|
| How virtual reality can help visualise and assess geohazards  | Geohazard research requires extensive spatiotemporal understanding based on an adequate multi-scale representation of modelling results. The most commonly applied representation basis for collected data is still the one of a 2D plane, typically a map. Digital maps of spatial data can be visualised and processed by using Geographic Information Systems. It is far less common to use 3D geomodels for the analysis and visualisation of spatial data. For the visualisation of both spatial and temporal hazard components, there are no standardised tools. We claim that a full geohazard assessment is only possible inside a new type of geoscientific and technological environment that is at the same time multi-dimensional, spatiotemporal, integrated, fully interactive (tele-)immersive, and collaborative. Surface and subsurface processes are interacting at various scales that are difficult to be overviewed at once. <b>Virtual Reality (VR) technology</b> could provide an attractive solution to overcome the multi-dimensional and spatiotemporal obstacles. The review of geoscientific applications using VR technology developed by multiple teams around the world shows that some solutions have already been developed many years ago, but widespread use was not possible. This is clearly changing now and soon we will see if VR can contribute to a better understanding of geo-processes. © 2017, © 2017 Informa UK Limited, trading as Taylor & Francis Group.   | 4        |
| Integrating career development learning into the curriculum: Collaboration with the careers service for employability | Career development learning has a demonstrable positive impact on the graduate employability of higher education learners. This is particularly the case if it is integrated into the curriculum rather than experienced as an add-on or included in finite curriculum elements. However, integration of career development learning into curriculum is a significant and challenging undertaking in course design, and also in facilitation of learning experiences. Academics manage crowded curricula in their disciplinary areas, and many also have external course accreditation requirements to deal with that may not include career development elements. In many institutions there is mixed understanding of what career development learning entails, no clear top-level strategic support, and unprecedented numbers of enrolled students across digital and on-campus provision. This article explores challenges and opportunities in <b>integrating career development learning into curriculum in higher education</b> , and identifies effective strategies for doing so at institutional, school, and program levels. It draws upon case studies comprising more than 30 interviews across nine universities in Australia and internationally, exploring how cross-disciplinary collaboration between career development practitioners, learning and curriculum designers, and academic units can be effective in enacting curricular career development learning at scale. The article suggests strategies for institutional leaders, academics, and careers practitioners in higher education institutions at different stages in the curricular career development learning journey. © 2019 Deakin University. All rights reserved. | 4        |

Full data file on figshare: [Scopus-papers-titles-abstracts-by-cited-2019.csv](#)

**Table 8.** Titles and abstracts of the most cited papers (2017-2018)

| Title   | Abstract  | Cited by |
|---|---|----------|
| Securing smart cities using blockchain technology | A <b>smart city</b> uses information technology to <b>integrate and manage physical, social, and business infrastructures</b> in order to provide better services to its dwellers while ensuring efficient and optimal utilization of available resources. With the proliferation of technologies such as <b>Internet of Things (IoT), cloud computing, and interconnected networks</b> , smart cities can deliver innovative solutions and more direct interaction and collaboration between citizens and the local government. Despite a number of potential benefits, digital disruption poses many challenges related to <b>information security and privacy</b> . This paper proposes a <b>security framework that integrates the blockchain technology with smart devices</b> to provide a secure communication platform in a smart city. B© 2016 IEEE. | 97       |

| Title  | Abstract  | Cited by |
|--|---|----------|
| The relation between 21st-century skills and digital skills: AB systematic literature review | <p>Innovation starts with people, making the human capital within the workforce decisive. In a fast-changing knowledge economy, 21st-century <b>digital skills</b> drive organizations' competitiveness and innovation capacity. Although such skills are seen as crucial, the digital aspect integrated with 21st-century skills is not yet sufficiently defined. The main objectives of this study were to (1) examine the relation between 21st-century skills and digital skills; and (2) provide a framework of 21st-century digital skills with conceptual dimensions and key operational components aimed at the knowledge worker. A <b>systematic literature review</b> was conducted to synthesize the relevant academic literature concerned with 21st-century digital skills. In total, 1592 different articles were screened from which 75 articles met the predefined inclusion criteria. The results show that 21st-century skills are broader than digital skills as the list of mentioned skills is far more extensive. In addition, in contrast to digital skills, 21st-century skills are not necessarily underpinned by ICT. Furthermore, we identified <b>seven core skills: technical, information management, communication, collaboration, creativity, critical thinking and problem solving</b>. Five contextual skills were also identified: ethical awareness, cultural awareness, flexibility, self-direction and lifelong learning. B© 2017 Elsevier Ltd</p>  | 91       |
| An energy-aware service composition algorithm for multiple cloud-based IoT applications      | <p>There has been a <b>shift in research towards the convergence of the Internet-of-Things (IoT) and cloud computing paradigms</b> motivated by the need for IoT applications to leverage the unique characteristics of the cloud. IoT acts as an enabler to interconnect intelligent and self-configurable nodes to establish an efficient and dynamic platform for communication and collaboration. IoT is becoming a major source of big data, contributing huge amounts of streamed information from a large number of interconnected nodes, which have to be stored, processed, and presented in an efficient, and easily interpretable form. Cloud computing can enable IoT to have the privilege of a virtual resources utilization infrastructure, which integrates storage devices, visualization platforms, resource monitoring, analytical tools, and client delivery. Given the number of things connected and the amount of data generated, a key challenge is the energy efficient composition and interoperability of heterogeneous things integrated with cloud resources and scattered across the globe, in order to create an <b>on-demand energy efficient cloud based IoT application</b>. In many cases, when a single service is not enough to complete the business requirement; a composition of web services is carried out. These composed web services are expected to collaborate towards a common goal with large amount of data exchange and various other operations. <b>Massive data sets</b> have to be exchanged between several geographically distributed and scattered services. The movement of mass data between services influences the whole application process in terms of energy consumption. One way to significantly reduce this massive data exchange is to use fewer services for a composition, which need to be created to complete a business requirement. Integrating fewer services can result in a reduction in data interchange, which in return helps in reducing the energy consumption and carbon footprint. This paper develops a novel multi-cloud IoT service composition algorithm called (E2C2) that aims at creating an energy-aware composition plan by searching for and integrating the least possible number of IoT services, in order to fulfil user requirements. A formal user requirements translation and transformation modelling and analysis is adopted for the proposed algorithm. The algorithm was evaluated against four established service composition algorithms in multiple cloud environments (All clouds, Base cloud, Smart cloud, and COM2), with the results demonstrating the superior performance of our approach. B© 2017 Elsevier Ltd</p> | 76       |
| Industrial Cyberphysical Systems: A Backbone of the Fourth Industrial Revolution             | <p><b>Cyberphysical systems (CPSs)</b> are perceived as the pivotal enabler for a new era of <b>real-time Internetbased communication and collaboration among value-chain participants</b>, e.g., devices, systems, organizations, and humans. The CPS utilization in industrial settings is expected to revolutionize the way enterprises conduct their business from a holistic viewpoint, i.e., from shop-floor to business interactions, from suppliers to customers, and from design <b>to support across the whole product and service lifecycle</b>. Industrial CPS (ICPSs) blur the fabric of cyber (including business) and physical worlds and kickstart an era of systemwide collaboration and information-driven interactions among all stakeholders of the value chain. Therefore, ICPSSs are expected to empower the transformation of industry and business at large to a digital, adaptive, networked, and knowledge-based industry with significant long-term impact on the economy, society, environment, and citizens. B© 2017 IEEE.</p>   | 65       |

| Title  | Abstract  | Cited by |
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| Embracing digital innovation in incumbent firms: How Volvo Cars managed competing concerns   | Past research provides instructive yet incomplete answers as to how incumbent firms can address competing concerns as they embrace digital innovation. In particular, it offers only partial explanations of why different concerns emerge, how they manifest, and how firms can manage them. In response, we present a longitudinal case study of Volvo Cars'connected car initiative. Combining extant literature with insights from the case, we argue that incumbent firms face four competing concerns-capability (existing versus requisite), focus (product versus process), collaboration (internal versus external), and governance (control versus flexibility)-and that these concerns are systemically interrelated. Firms must therefore manage these concerns cohesively by continuously balancing new opportunities and established practices.   | 62       |
| The motus wildlife tracking system: A collaborative research network to enhance the understanding of wildlife movement [Le syst me de suivi de la faune motus: Un r seau de recherche collaboratif visant   mieux comprendre le d placement des animaux] | We describe a new collaborative network, the Motus Wildlife Tracking System (Motus; <a href="https://motus.org">https://motus.org</a> ), which is an international network of researchers using coordinated automated radio-telemetry arrays to study movements of small flying organisms including birds, bats, and insects, at local, regional, and hemispheric scales. Radio-telemetry has been a cornerstone of tracking studies for over 50 years, and because of current limitations of geographic positioning systems (GPS) and satellite transmitters, has remained the primary means to track movements of small animals with high temporal and spatial precision. Automated receivers, along with recent miniaturization and digital coding of tags, have further improved the utility of radio-telemetry by allowing many individuals to be tracked continuously and simultaneously across broad landscapes. Motus is novel among automated arrays in that collaborators employ a single radio frequency across receiving stations over a broad geographic scale, allowing individuals to be detected at sites maintained by others. Motus also coordinates, disseminates, and archives detections and associated metadata in a central repository. Combined with the ability to track many individuals simultaneously, Motus has expanded the scope and spatial scale of research questions that can be addressed using radio-telemetry from local to regional and even hemispheric scales. Since its inception in 2012, more than 9000 individuals of over 87 species of birds, bats, and insects have been tracked, resulting in more than 250 million detections. This rich and comprehensive dataset includes detections of individuals during all phases of the annual cycle (breeding, migration, and nonbreeding), and at a variety of spatial scales, resulting in novel insights into the movement behavior of small flying animals. The value of the Motus network will grow as spatial coverage of stations and number of partners and collaborators increases. With continued expansion and support, Motus can provide a framework for global collaboration, and a coordinated approach to solving some of the most complex problems in movement biology and ecology. B  2017 by the author(s). | 59       |
| Integrating blockchain for data sharing and collaboration in mobile healthcare applications  | Enabled by mobile and wearable technology, personal health data delivers immense and increasing value for healthcare, benefiting both care providers and medical research. The secure and convenient sharing of personal health data is crucial to the improvement of the interaction and collaboration of the healthcare industry. Faced with the potential privacy issues and vulnerabilities existing in current personal health data storage and sharing systems, as well as the concept of self-sovereign data ownership, we propose an innovative user-centric health <b>data sharing solution by utilizing a decentralized and permissioned blockchain to protect privacy</b> using channel formation scheme and enhance the identity management using the membership service supported by the blockchain. A mobile application is deployed to collect health data from personal wearable devices, manual input, and medical devices, and synchronize data to the cloud for data sharing with healthcare providers and health insurance companies. To preserve the integrity of health data, within each record, a proof of integrity and validation is permanently retrievable from cloud database and is anchored to the blockchain network. Moreover, for scalable and performance considerations, we adopt a tree-based data processing and batching method to handle large data sets of personal health data collected and uploaded by the mobile platform. B  2017 IEEE.   | 57       |



| Title  | Abstract  | Cited by |
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| RCSB Protein Data Bank: Sustaining a living digital data resource that enables breakthroughs in scientific research and biomedical education | <p><b>The Protein Data Bank (PDB)</b> is one of two archival resources for experimental data central to biomedical research and education worldwide (the other key Primary Data Archive in biology being the International Nucleotide Sequence Database Collaboration). The PDB currently houses &gt;134,000 atomic level biomolecular structures determined by crystallography, NMR spectroscopy, and 3D electron microscopy. It was established in 1971 as the first open-access, digital-data resource in biology, and is managed by the Worldwide Protein Data Bank partnership (wwPDB; wwpdb.org). US PDB operations are conducted by the RCSB Protein Data Bank (RCSB PDB; RCSB.org; Rutgers University and UC San Diego) and funded by NSF, NIH, and DoE. The RCSB PDB serves as the global Archive Keeper for the wwPDB. During calendar 2016, &gt;591 million structure data files were downloaded from the PDB by Data Consumers working in every sovereign nation recognized by the United Nations. During this same period, the RCSB PDB processed &gt;5300 new atomic level biomolecular structures plus experimental data and metadata coming into the archive from Data Depositors working in the Americas and Oceania. In addition, RCSB PDB served &gt;1 million RCSB.org users worldwide with PDB data integrated with 40 external data resources providing rich structural views of fundamental biology, biomedicine, and energy sciences, and &gt;600,000 PDB101.rcsb.org educational website users around the globe. RCSB PDB resources are described in detail together with metrics documenting the impact of access to PDB data on basic and applied research, clinical medicine, education, and the economy. B© 2017 The Authors Protein Science published by Wiley Periodicals, Inc. on behalf of The Protein Society</p>   | 49       |
| The complete digital workflow in fixed prosthodontics: A systematic review   | <p>Background: The continuous development in dental processing ensures new opportunities in the field of fixed prosthodontics in a complete virtual environment without any physical model situations. The aim was to compare fully digitalized workflows to conventional and/or mixed analog-digital workflows for the treatment with tooth-borne or implant-supported fixed reconstructions. Methods: A PICO strategy was executed using an electronic (MEDLINE, EMBASE, Google Scholar) plus manual search up to 2016-09-16 focusing on RCTs investigating complete digital workflows in fixed prosthodontics with regard to economics or esthetics or patient-centered outcomes with or without follow-up or survival/success rate analysis as well as complication assessment of at least 1 year under function. The search strategy was assembled from MeSH-Terms and unspecific free-text words: (((("Dental Prosthesis" [MeSH]) OR ("Crowns" [MeSH]) OR ("Dental Prosthesis, Implant-Supported" [MeSH])) OR ((crown) OR (fixed dental prosthesis) OR (fixed reconstruction) OR (dental bridge) OR (implant crown) OR (implant prosthesis) OR (implant restoration) OR (implant reconstruction))) AND (("Computer-Aided Design" [MeSH]) OR ((digital workflow) OR (digital technology) OR (computerized dentistry) OR (intraoral scan) OR (digital impression) OR (scanbody) OR (virtual design) OR (digital design) OR (cad/cam) OR (rapid prototyping) OR (monolithic) OR (full-contour))) AND (("Dental Technology" [MeSH] OR ((conventional workflow) OR (lost-wax-technique) OR (porcelain-fused-to-metal) OR (PFM) OR (implant impression) OR (hand-layering) OR (veneering) OR (framework))) AND (((("Study, Feasibility" [MeSH]) OR ("Survival" [MeSH]) OR ("Success" [MeSH]) OR ("Economics" [MeSH]) OR ("Costs, Cost Analysis" [MeSH]) OR ("Esthetics, Dental" [MeSH]) OR ("Patient Satisfaction" [MeSH])) OR ((feasibility) OR (efficiency) OR (patient-centered outcome))). Assessment of risk of bias in selected studies was done at a 'trial level' including random sequence generation, allocation concealment, blinding, completeness of outcome data, selective reporting, and other bias using the Cochrane Collaboration tool. A judgment of risk of bias was assigned if one or more key domains had a high or unclear risk of bias. An official registration of the systematic review was not performed. Results: The systematic search identified 67 titles, 32 abstracts thereof were screened, and subsequently, three full-texts included for data extraction. Analysed RCTs were heterogeneous without follow-up. One study demonstrated that fully digitally produced dental crowns revealed the feasibility of the process itself; however, the marginal precision was lower for lithium disilicate (LS2) restorations (113.8 Ojm) compared to conventional metal-ceramic (92.4 Ojm) and zirconium dioxide (ZrO2) crowns (68.5 Ojm) (p &lt; 0.05). Another study showed that leucite-reinforced glass ceramic crowns were esthetically favoured by the patients (8/2 crowns) and clinicians (7/3 crowns) (p &lt; 0.05). The third study investigated implant crowns. The complete digital workflow was more than twofold faster (75.3 min) in comparison to the mixed analog-digital workflow (156.6 min) (p &lt; 0.05). No RCTs could be found investigating multi-unit fixed dental prostheses (FDP). Conclusions: The number of RCTs testing complete digital workflows in fixed prosthodontics is low. Scientifically proven recommendations for clinical routine cannot be given at this time. Research with high-quality trials seems to be slower than the industrial progress of available digital applications. Future research with well-designed RCTs including follow-up observation is compellingly necessary in the field of complete digital processing. B© 2017 The Author(s).</p> | 39       |

| Title  | Abstract   | Cited by |
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| Using computer, mobile and wearable technology enhanced interventions to reduce sedentary behaviour: a systematic review and meta-analysis | <p><b>BACKGROUND:</b> High levels of sedentary behaviour (SB) are associated with negative health consequences. Technology enhanced solutions such as mobile applications, activity monitors, prompting software, texts, emails and websites are being harnessed to reduce SB. The aim of this paper is to evaluate the effectiveness of such technology enhanced interventions aimed at reducing SB in healthy adults and to examine the behaviour change techniques (BCTs) used.<b>METHODS:</b> Five electronic databases were searched to identify randomised-controlled trials (RCTs), published up to June 2016. Interventions using computer, mobile or wearable technologies to facilitate a reduction in SB, using a measure of sedentary time as an outcome, were eligible for inclusion. Risk of bias was assessed using the Cochrane Collaboration's tool and interventions were coded using the BCT Taxonomy (v1).<b>RESULTS:</b> Meta-analysis of 15/17 RCTs suggested that computer, mobile and wearable technology tools resulted in a mean reduction of -41.28B min per day (min/day) of sitting time (95% CI -60.99, -21.58, I2B =B 77%, nB =B 1402), in favour of the intervention group at end point follow-up. The pooled effects showed mean reductions at short (B%o× 3B months), medium (&gt;3 to 6B months), and long-term follow-up (&gt;6B months) of -42.42B min/day, -37.23B min/day and -1.65B min/day, respectively. Overall, 16/17 studies were deemed as having a high or unclear risk of bias, and 1/17 was judged to be at a low risk of bias. A total of 46 BCTs (14 unique) were coded for the computer, mobile and wearable components of the interventions. The most frequently coded were "prompts and cues", "self-monitoring of behaviour", "social support (unspecified)" and "goal setting (behaviour)".<b>CONCLUSION:</b> Interventions using computer, mobile and wearable technologies can be effective in reducing SB. Effectiveness appeared most prominent in the short-term and lessened over time. A range of BCTs have been implemented in these interventions. Future studies need to improve reporting of BCTs within interventions and address the methodological flaws identified within the review through the use of more rigorously controlled study designs with longer-term follow-ups, objective measures of SB and the incorporation of strategies to reduce attrition.<b>TRIAL REGISTRATION:</b> The review protocol was registered with PROSPERO: CRD42016038187.</p> | 35       |
| The digital twin of an industrial production line within the industry 4.0 concept  | <p>This article presents the digital twin concept, which is an augmented manufacturing project created in close collaboration by SOVA Digital and the Institute of Automation, Measurement and Applied Informatics (IAMA), of the Faculty of Mechanical Engineering, Slovak University of Technology in Bratislava with the support of SIEMENS. The project is a technological concept focusing on the continuous optimization of production processes, proactive maintenance, and continuous processing of process data. This project is the basis for further work to promote the concept of Industry 4.0. for the needs of the industry subjects within Slovakia. Its basic goal is to support the existing production structures within the automotive industry and the most efficient use of resources by augmented production and planning strategies, such as the digital twin presented here. B© 2017 IEEE.</p>  | 35       |
| Hard Two-Photon Contribution to Elastic Lepton-Proton Scattering Determined by the OLYMPUS Experiment                                      | <p>The OLYMPUS Collaboration reports on a precision measurement of the positron-proton to electron-proton elastic cross section ratio, R2Oi, a direct measure of the contribution of hard two-photon exchange to the elastic cross section. In the OLYMPUS measurement, 2.01 GeV electron and positron beams were directed through a hydrogen gas target internal to the DORIS storage ring at DESY. A toroidal magnetic spectrometer instrumented with drift chambers and time-of-flight scintillators detected elastically scattered leptons in coincidence with recoiling protons over a scattering angle range of B%o€20B° to 80B°. The relative luminosity between the two beam species was monitored using tracking telescopes of interleaved gas electron multiplier and multiwire proportional chamber detectors at 12B°, as well as symmetric Mfeller or Bhabha calorimeters at 1.29B°. A total integrated luminosity of 4.5 fb-1 was collected. In the extraction of R2Oi, radiative effects were taken into account using a Monte Carlo generator to simulate the convolutions of internal bremsstrahlung with experiment-specific conditions such as detector acceptance and reconstruction efficiency. The resulting values of R2Oi, presented here for a wide range of virtual photon polarization 0.456&lt;Πμ&lt;0.978, are smaller than some hadronic two-photon exchange calculations predict, but are in reasonable agreement with a subtracted dispersion model and a phenomenological fit to the form factor data. B© 2017 American Physical Society.</p>  | 34       |

| Title   | Abstract  | Cited by |
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| Factors for effective BIM governance  | <p>With increasing complexity of construction projects, a collaborative environment becomes essential to ensure effective communication during the project lifecycle. Conventional team collaboration raises issues such as the lack of trust; uncertainties regarding ownership and Intellectual Property Rights (IPRs); miscommunication; and cultural differences, among others. Additional issues can arise in relation to the generated data, including data loss, data inconsistency, errors, and liability for wrong or incomplete data. Furthermore, There is a shortage of studies that investigate collaboration practices, data management, and governance issues from a socio-technical perspective. This study investigates the development of a BIM governance framework (G-BIM) with support of Cloud technologies, identifying effectiveness factors that guarantee successful collaboration. Semi-structured interviews were conducted with informed BIM experts in the UK, with the aim of: (i) discovering current trends in Information Communication Technologies (ICT) and team collaboration during construction projects; (ii) exploring barriers to BIM adoption; (iii) exploring the role of BIM-related standards; (iv) consulting BIM experts to develop a Cloud-based BIM governance solution to tackle team collaboration on BIM-based projects; and (v) investigating the role of Cloud in supporting BIM governance research and development. The findings reveal several BIM adoption barriers and issues directly influencing team collaboration. The key findings led to the development of a BIM governance framework (G-BIM). The purpose of the G-BIM framework is to present and summarise effective factors resulting in successful governance and a collaborative BIM approach, to support the future development of a Cloud-based BIM governance platform. The G-BIM framework comprises three main components: (i) actors and team, (ii) data management and ICT, and (iii) processes and contracts. Furthermore, the study reveals the high potential of Cloud technologies to advance current BIM governance solutions, because of its performance capabilities, accessibility, storage, and scalability. B© 2017 Elsevier Ltd</p> | 32       |
| An Internet of Things-enabled BIM platform for on-site assembly services in prefabricated construction  | <p>Building Information Modelling (BIM) serves as a useful tool in facilitating the on-site assembly services (OAS) of prefabricated construction for its benefits of powerful management of physical and functional digital presentations. However, the benefits of using BIM in the OAS of prefabricated construction cannot be cultivated with an incomplete, inaccurate, and untimely data exchange and lack of real-time visibility and traceability. To deal with these challenges, an Internet of Things (IoT)-enabled platform is designed by integrating IoT and BIM for prefabricated public housing projects in Hong Kong. The demands of the stakeholders were analysed; then smart construction objects (SCOs) and smart gateway are defined and designed to collect real-time data throughout the working processes of on-site assembly of prefabricated construction using the radio frequency identification (RFID) technology. The captured data is uploaded to cloud in real-time to process and analyse for decision support purposes for the involved site managers and workers. Visibility and traceability functions are developed with BIM and virtual reality (VR) technologies, through which managers can supervise the construction progress and approximate cost information in a real-time manner. The IoT-enabled platform can provide various decision support tools and services to different stakeholders, for improving the efficiency and effectiveness of daily operations, decision making, collaboration, and supervision throughout on-site assembly processes of prefabricated construction. B© 2018 Elsevier B.V.</p>  | 31       |
| Technology Firms Shape Political Communication: The Work of Microsoft, Facebook, Twitter, and Google With Campaigns During the 2016 U.S. Presidential Cycle | <p>This article offers the first analysis of the role that technology companies, specifically Facebook, Twitter, Microsoft, and Google, play in shaping the political communication of electoral campaigns in the United States. We offer an empirical analysis of the work technology firms do around electoral politics through interviews with staffers at these firms and digital and social media directors of 2016B U.S. presidential primary and general election campaigns, in addition to field observations at the 2016 Democratic National Convention. We find that technology firms are motivated to work in the political space for marketing, advertising revenue, and relationship-building in the service of lobbying efforts. To facilitate this, these firms have developed organizational structures and staffing patterns that accord with the partisan nature of American politics. Furthermore, Facebook, Twitter, and Google go beyond promoting their services and facilitating digital advertising buys, actively shaping campaign communication through their close collaboration with political staffers. We show how representatives at these firms serve as quasi-digital consultants to campaigns, shaping digital strategy, content, and execution. Given this, we argue that political communication scholars need to consider social media firms as more active agents in political processes than previously appreciated in the literature. Copyright B© 2018 Taylor &amp; Francis Group, LLC.</p>  | 30       |

| Title  | Abstract  | Cited by |
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| Effect of a game-based intervention designed to enhance social incentives to increase physical activity among families: The BE FIT randomized clinical trial | <p>IMPORTANCE: Gamification, the application of game design elements such as points and levels in nongame contexts, is often used in digital health interventions, but evidence on its effectiveness is limited. OBJECTIVE: To test the effectiveness of a gamification intervention designed using insights from behavioral economics to enhance social incentives within families to increase physical activity. DESIGN, SETTING, AND PARTICIPANTS: The Behavioral Economics Framingham Incentive Trial (BE FIT) was a randomized clinical trial with a 12-week intervention period and a 12-week follow-up period. The investigation was a community-based study between December 7, 2015, and August 14, 2016. Participants in the modified intent-to-treat analysis were adults enrolled in the Framingham Heart Study, a long-standing cohort of families. INTERVENTIONS: All participants tracked daily step counts using a wearable device or a smartphone, established a baseline, selected a step goal increase, and received daily individual feedback on goal performance by text message or email for 24 weeks. Families in the gamification arm could earn points and progress through levels based on physical activity goal achievement during the 12-week intervention. The game design was meant to enhance collaboration, accountability, and peer support. MAIN OUTCOMES AND MEASURES: The primary outcome was the proportion of participant-days that step goals were achieved during the intervention period. Secondary outcomes included the proportion of participant-days that step goals were achieved during the follow-up period and the change in the mean daily steps during the intervention and follow-up periods. RESULTS: Among 200 adults comprising 94 families, the mean age was 55.4 years, and 56.0% (n = 112) were female. During the intervention period, participants in the gamification arm achieved step goals on a significantly greater proportion of participant-days (0.53 vs 0.32; adjusted difference, 0.27; 95% CI, 0.20-0.33; P &lt; .001) and had a significantly greater increase in the mean daily steps compared with baseline (1661 vs 636; adjusted difference, 953; 95% CI, 505-1401; P &lt; .001) than the control arm. During the follow-up period, physical activity in the gamification arm declined but remained significantly greater than that in the control arm for the proportion of participant-days achieving step goals (0.44 vs 0.33; adjusted difference, 0.12; 95% CI, 0.05-0.19; P &lt; .001) and the mean daily steps compared with baseline (1385 vs 798; adjusted difference, 494; 95% CI, 170-818; P &lt; .01). CONCLUSIONS AND RELEVANCE: Gamification designed to leverage insights from behavioral economics to enhance social incentives significantly increased physical activity among families in the community. TRIAL REGISTRATION: clinicaltrials.gov Identifier: NCT02531763. B© 2017 American Medical Association. All rights reserved.</p> | 29       |
| An investigation of IBM's Smarter Cites Challenge: What do participating cities want?  | <p>In 2010, IBM created the Smarter Cites Challenge to address critical issues of the 21st century through its digital expertise, in collaboration with city governments. Despite questions about the origin and intentions of IBM's involvement, 130 cities from all around the world took up the challenge in the first five years. There is limited case study research available on a number of participating cities which has not been able to unpack cities' rationale for working with IBM. This paper provides an index of all participating cities in the Smarter Cites Challenge, to understand the areas of interest in which urban governments have been seeking IBM's consulting service. Findings present the state of smart city thinking in urban governments, and raise questions about the multidimensional integration, if any, across the areas of focus in which digital technologies are shaping contemporary cities. B© 2017 Elsevier Ltd</p>  | 29       |
| BIM and the small construction firm: a critical perspective  | <p>The need for technological and administrative innovation is a recurrent theme in the UK construction-reform agenda, but generic improvement recipes are beginning to give way to a more focused prescription: building information modelling (BIM). The current strategy is to mandate the use of BIM for government projects as a way of integrating the design, construction and operation of publicly procured buildings. This aspiration represents a partial turn away from a focus on managerialist agendas towards a belief in the power of digital practices to achieve the aspiration of integrated working, collaboration and innovation, a trend that is being reflected globally in relation to both national and firm-level policy interventions. This paper subjects this so-called 'BIM revolution' to critical scrutiny. By drawing on theories of the digital divide, a critical discourse is developed around the ways in which political reform agendas centred on BIM might not stimulate innovation on a wider scale, but could act to disenfranchise small firms that are unable (or unwilling) to engage with them. This critical analysis presents important new research questions around the technocratic optimism that pervades the current reform discourse, the trajectory of industry development that it creates and the policy process itself. B© 2017 Informa UK Limited, trading as Taylor &amp; Francis Group.</p>  | 27       |

| Title   | Abstract   | Cited by |
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| A collaborative approach to identifying social media markers of schizophrenia by employing machine learning and clinical appraisals | Background: Linguistic analysis of publicly available Twitter feeds have achieved success in differentiating individuals who self-disclose online as having schizophrenia from healthy controls. To date, limited efforts have included expert input to evaluate the authenticity of diagnostic self-disclosures. Objective: This study aims to move from noisy self-reports of schizophrenia on social media to more accurate identification of diagnoses by exploring a human-machine partnered approach, wherein computational linguistic analysis of shared content is combined with clinical appraisals. Methods: Twitter timeline data, extracted from 671 users with self-disclosed diagnoses of schizophrenia, was appraised for authenticity by expert clinicians. Data from disclosures deemed true were used to build a classifier aiming to distinguish users with schizophrenia from healthy controls. Results from the classifier were compared to expert appraisals on new, unseen Twitter users. Results: Significant linguistic differences were identified in the schizophrenia group including greater use of interpersonal pronouns ( $P < .001$ ), decreased emphasis on friendship ( $P < .001$ ), and greater emphasis on biological processes ( $P < .001$ ). The resulting classifier distinguished users with disclosures of schizophrenia deemed genuine from control users with a mean accuracy of 88% using linguistic data alone. Compared to clinicians on new, unseen users, the classifier's precision, recall, and accuracy measures were 0.27, 0.77, and 0.59, respectively. Conclusions: These data reinforce the need for ongoing collaborations integrating expertise from multiple fields to strengthen our ability to accurately identify and effectively engage individuals with mental illness online. These collaborations are crucial to overcome some of mental illnesses' biggest challenges by using digital technology. B© Michael L Birnbaum, Sindhu Kiranmai Ernala, Asra F Rizvi, Munmun De Choudhury, John M Kane. | 24       |
| Secure and efficient data collaboration with hierarchical attribute-based encryption in cloud computing                             | With the increasing trend of outsourcing data to the cloud for efficient data storage, <b>secure data collaboration service</b> including data read and write in cloud computing is urgently required. However, it introduces many new challenges toward data security. The key issue is how to afford secure write operation on ciphertext collaboratively, and the other issues include difficulty in key management and heavy computation overhead on user since cooperative users may read and write data using any device. In this paper, we propose a secure and efficient data collaboration scheme, in which <b>fine-grained access control of ciphertext and secure data writing operation can be afforded based on attribute-based encryption (ABE)</b> and <b>attribute-based signature (ABS)</b> respectively. In order to relieve the attribute authority from heavy key management burden, our scheme employs a full delegation mechanism based on <b>hierarchical attribute-based encryption (HABE)</b> . Further, we also propose a partial decryption and signing construction by delegating most of the computation overhead on user to cloud service provider. The security and performance analysis show that our scheme is secure and efficient. B© 2016 Elsevier B.V.  | 24       |

Full data file on figshare: [Scopus-papers-titles-abstracts-by-cited-2017-2018.csv](#)

**Table 9.** Titles and abstracts of the most cited papers (2015-2016)

| Title   | Abstract  | Cited by |
|---|---|----------|
| Cloud-based design and manufacturing: A new paradigm in digital manufacturing and design innovation | Cloud-based design manufacturing (CBDM) refers to a service-oriented networked product development model in which service consumers are enabled to configure, select, and utilize customized product realization resources and services ranging from computer-aided engineering software to reconfigurable manufacturing systems. An ongoing debate on CBDM in the research community revolves around several aspects such as definitions, key characteristics, computing architectures, communication and collaboration processes, crowdsourcing processes, information and communication infrastructure, programming models, data storage, and new business models pertaining to CBDM. One question, in particular, has often been raised: is cloud-based design and manufacturing actually a new paradigm, or is it just "old wine in new bottles"? To answer this question, we discuss and compare the existing definitions for CBDM, identify the essential characteristics of CBDM, define a systematic requirements checklist that an idealized CBDM system should satisfy, and compare CBDM to other relevant but more traditional collaborative design and distributed manufacturing systems such as web- and agent-based design and manufacturing systems. To justify the conclusion that CBDM can be considered as a new paradigm that is anticipated to drive digital manufacturing and design innovation, we present the development of a smart delivery drone as an idealized CBDM example scenario and propose a corresponding CBDM system architecture that incorporates CBDM-based design processes, integrated manufacturing services, information and supply chain management in a holistic sense. © 2014 Elsevier Ltd. All rights reserved. | 293      |

| Title   | Abstract  | Cited by |
|---|---|----------|
| Performing the sharing economy                            | <p>The sharing economy converges around activities facilitated through digital platforms that enable peer-to-peer access to goods and services. It constitutes an apparent paradox, framed as both part of the capitalist economy and as an alternative. This duplicity necessitates focusing on the performances of the sharing economy: how it simultaneously constructs diverse economic activities whilst also inviting the deconstruction of ongoing practices of dominance. Such performances hold open the question of what the (sharing) economy is, suspending it as a space for both opportunity and critique. Drawing on participant observation at a sharing economy 'festival' and analysis of the vocabularies of online platforms, the paper outlines three performances of sharing through community, access and collaboration. It argues through these performances that the sharing economy is contingent and complexly articulated. It has the potential to both shake up and further entrench 'business-as-usual' through the ongoing reconfiguration of a divergent range of (economic) activities. Whilst offering an antidote to the narrative of economy as engendering isolation and separation, the sharing economy simultaneously masks new forms of inequality and polarisations of ownership. Nonetheless, the paper concludes in suggesting that by pointing to wider questions concerning participation in, access to and production of resources, the sharing economy should not be dismissed. Instead, it should serve as prompt to engage with 'digital' transformations of economy in the spirit of affirmative critique that might enact the promise of doing economy differently. © 2015 Elsevier Ltd.</p>   | 112      |
| Mobile apps for science learning: Review of research      | <p>This review examined articles on mobile apps for science learning published from 2007 to 2014. A qualitative content analysis was used to investigate the science mobile app research for its mobile app design, underlying theoretical foundations, and students' measured outcomes. This review found that mobile apps for science learning offered a number of similar design features, including technology-based scaffolding, location-aware functionality, visual/audio representations, digital knowledge-construction tools, digital knowledge-sharing mechanisms, and differentiated roles. Many of the studies cited a specific theoretical foundation, predominantly situated learning theory, and applied this to the design of the mobile learning environment. The most common measured outcome was students' basic scientific knowledge or conceptual understanding. A number of recommendations came out of this review. Future studies need to make use of newer, available technologies; isolate the testing of specific app features; and develop additional strategies around using mobile apps for collaboration. Researchers need to make more explicit connections between the instructional principles and the design features of their mobile learning environment in order to better integrate theory with practice. In addition, this review noted that stronger alignment is needed between the underlying theories and measured outcomes, and more studies are needed to assess students' higher-level cognitive outcomes, cognitive load, and skill-based outcomes such as problem solving. Finally, more research is needed on how science mobile apps can be used with more varied science topics and diverse audiences. © 2015 Elsevier Ltd. All rights reserved.</p> | 99       |
| Materials Data Science: Current Status and Future Outlook | <p>The field of materials science and engineering is on the cusp of a digital data revolution. After reviewing the nature of data science and Big Data, we discuss the features of materials data that distinguish them from data in other fields. We introduce the concept of process-structure-property (PSP) linkages and illustrate how the determination of PSPs is one of the main objectives of materials data science. Then we review a selection of materials databases, as well as important aspects of materials data management, such as storage hardware, archiving strategies, and data access strategies. We introduce the emerging field of materials data analytics, which focuses on data-driven approaches to extract and curate materials knowledge from available data sets. The critical need for materials e-collaboration platforms is highlighted, and we conclude the article with a number of suggestions regarding the near-term future of the materials data science field. Copyright © 2015 by Annual Reviews. All rights reserved.</p>   | 95       |

| Title  | Abstract   | Cited by |
|--|--|----------|
| Collaborative modeling of the benefits and harms associated with different U.S. Breast cancer screening strategies | <p>Background: Controversy persists about optimal mammography screening strategies. Objective: To evaluate screening outcomes, taking into account advances in mammography and treatment of breast cancer. Design: Collaboration of 6 simulation models using national data on incidence, digital mammography performance, treatment effects, and other-cause mortality. Setting: United States. Patients: Average-risk U.S. female population and subgroups with varying risk, breast density, or comorbidity. Intervention: Eight strategies differing by age at which screening starts (40, 45, or 50 years) and screening interval (annual, biennial, and hybrid [annual for women in their 40s and biennial thereafter]). All strategies assumed 100% adherence and stopped at age 74 years. Measurements: Benefits (breast cancer-specific mortality reduction, breast cancer deaths averted, life-years, and quality-adjusted life-years); number of mammograms used; harms (false-positive results, benign biopsies, and overdiagnosis); and ratios of harms (or use) and benefits (efficiency) per 1000 screens. Results: Biennial strategies were consistently the most efficient for average-risk women. Biennial screening from age 50 to 74 years avoided a median of 7 breast cancer deaths versus no screening; annual screening from age 40 to 74 years avoided an additional 3 deaths, but yielded 1988 more false-positive results and 11 more overdiagnoses per 1000 women screened. Annual screening from age 50 to 74 years was inefficient (similar benefits, but more harms than other strategies). For groups with a 2-to 4-fold increased risk, annual screening from age 40 years had similar harms and benefits as screening average-risk women biennially from 50 to 74 years. For groups with moderate or severe comorbidity, screening could stop at age 66 to 68 years. Limitation: Other imaging technologies, polygenic risk, and nonadherence were not considered. Conclusion: Biennial screening for breast cancer is efficient for average-risk populations. Decisions about starting ages and intervals will depend on population characteristics and the decision makers' weight given to the harms and benefits of screening.</p> | 92       |
| Digital health interventions for the prevention of cardiovascular disease: A systematic review and meta-analysis   | <p>Objective To assess the potential benefit of digital health interventions (DHIs) on cardiovascular disease (CVD) outcomes (CVD events, all-cause mortality, hospitalizations) and risk factors compared with non-DHIs. Patients and Methods We conducted a systematic search of PubMed, MEDLINE, EMBASE, Web of Science, Ovid, CINHAL, ERIC, PsychINFO, Cochrane, and Cochrane Central Register of Controlled Trials for articles published from January 1, 1990, through January 21, 2014. Included studies examined any element of DHI (telemedicine, Web-based strategies, e-mail, mobile phones, mobile applications, text messaging, and monitoring sensors) and CVD outcomes or risk factors. Two reviewers independently evaluated study quality utilizing a modified version of the Cochrane Collaboration risk assessment tool. Authors extracted CVD outcomes and risk factors for CVD such as weight, body mass index, blood pressure, and lipid levels from 51 full-text articles that met validity and inclusion criteria. Results Digital health interventions significantly reduced CVD outcomes (relative risk, 0.61; 95% CI, 0.46-0.80; <math>P &lt; .001</math>; <math>I^2 = 22\%</math>). Concomitant reductions in weight (-2.77 lb [95% CI, -4.49 to -1.05 lb]; <math>P &lt; .002</math>; <math>I^2 = 97\%</math>) and body mass index (-0.17 kg/m<sup>2</sup> [95% CI, -0.32 kg/m<sup>2</sup> to -0.01 kg/m<sup>2</sup>]; <math>P = .03</math>; <math>I^2 = 97\%</math>) but not blood pressure (-1.18 mm Hg [95% CI, -2.93 mm Hg to 0.57 mm Hg]; <math>P = .19</math>; <math>I^2 = 100\%</math>) were found in these DHI trials compared with usual care. In the 6 studies reporting Framingham risk score, 10-year risk percentages were also significantly improved (-1.24%; 95% CI, -1.73% to -0.76%; <math>P &lt; .001</math>; <math>I^2 = 94\%</math>). Results were limited by heterogeneity not fully explained by study population (primary or secondary prevention) or DHI modality. Conclusion Overall, these aggregations of data provide evidence that DHIs can reduce CVD outcomes and have a positive impact on risk factors for CVD. © 2015 Mayo Foundation for Medical Education and Research.</p>                             | 88       |
| Capability Driven Development: An Approach to Designing Digital Enterprises  | <p>The need for organizations to operate in changing environments is addressed by proposing an approach that integrates organizational development with information system (IS) development taking into account changes in the application context of the solution. This is referred to as Capability Driven Development (CDD). A meta-model representing business and IS designs consisting of goals, key performance indicators, capabilities, context and capability delivery patterns, is being proposed. The use of the meta-model is validated in three industrial case studies as part of an ongoing collaboration project, whereas one case is presented in the paper. Issues related to the use of the CDD approach, namely, CDD methodology and tool support are also discussed. © 2015 Springer Fachmedien.</p>   | 81       |

| Title   | Abstract   | Cited by |
|---|--|----------|
| Constructionist Gaming: Understanding the Benefits of Making Games for Learning                   | <p>There has been considerable interest in examining the educational potential of playing video games. One crucial element, however, has traditionally been left out of these discussions—namely, children's learning through making their own games. In this article, we review and synthesize 55 studies from the last decade on making games and learning. We found that the majority of studies focused on teaching coding and academic content through game making, and that few studies explicitly examined the roles of collaboration and identity in the game making process. We argue that future discussions of serious gaming ought to be more inclusive of constructionist approaches to realize the full potential of serious gaming. Making games, we contend, not only more genuinely introduces children to a range of technical skills but also better connects them to each other, addressing the persistent issues of access and diversity present in traditional digital gaming cultures. © 2015, Yasmin B. Kafai and Quinn Burke.</p>   | 67       |
| Energy efficient automated control of irrigation in agriculture by using wireless sensor networks | <p>Many agricultural activities can be highly enhanced by using digital technologies. One of these activities is the regulation of the quantity of water in cultivated fields, a process which is directly interwoven with the sustainability and the productivity of crops, since insufficient or excessive irrigation may not only be obstructive, but also destructive. This paper proposes a scheme based on the collaboration of an integrated system for automated irrigation management with an advanced novel routing protocol for Wireless Sensor Networks (WSNs), named ECHERP (Equalized Cluster Head Election Routing Protocol). At its core, the proposed system aims at efficiently managing water supply in cultivated fields in an automated way. The system takes into consideration the historical data and the change on the climate values to calculate the quantity of water that is needed for irrigation. In case that the change on the collected values is above a threshold more frequent data collection is proposed to minimize the necessary quantity of water. On the other hand, in case that the change of the values is below a preset threshold then the time interval to collect data can increase to save sensor energy, leading to a prolonged sensor lifetime. The results show that network lifetime using ECHERP is improved up to 1825. min and if a round is 110. s the model provides energy efficiency using smaller water quantities. © 2015 Elsevier B.V.</p>  | 67       |
| Constraint on neutrino masses from SDSS-III/BOSS Ly $\alpha$ forest and other cosmological probes | <p>We present constraints on the parameters of the <math>\Lambda</math>CDM cosmological model in the presence of massive neutrinos, using the one-dimensional Ly<math>\alpha</math> forest power spectrum obtained with the Baryon Oscillation Spectroscopic Survey (BOSS) of the Sloan Digital Sky Survey (SDSS) by Palanque-Delabrouille et al. [1], complemented by additional cosmological probes. The interpretation of the measured Ly<math>\alpha</math> spectrum is done using a second-order Taylor expansion of the simulated power spectrum. BOSS Ly<math>\alpha</math> data alone provide better bounds than previous Ly<math>\alpha</math> results, but are still poorly constraining, especially for the sum of neutrino masses <math>\Sigma m_\nu</math>, for which we obtain an upper bound of 1.1 eV (95% CL), including systematics for both data and simulations. Ly<math>\alpha</math> constraints on <math>\Lambda</math>CDM parameters and neutrino masses are compatible with CMB bounds from the <math>\{ \rm Planck \}</math> collaboration [2]. Interestingly, the combination of Ly<math>\alpha</math> with CMB data reduces the uncertainties significantly, due to very different directions of degeneracy in parameter space, leading to the strongest cosmological bound to date on the total neutrino mass, <math>\Sigma m_\nu &lt; 0.15</math> eV at 95% CL (with a best-fit in zero). Adding recent BAO results further tightens this constraint to <math>\Sigma m_\nu &lt; 0.14</math> eV at 95% CL. This bound is nearly independent of the statistical approach used, and of the different combinations of CMB and BAO data sets considered in this paper in addition to Ly<math>\alpha</math>. Given the measured values of the two squared mass differences <math>\Delta m^2</math>, this result tends to favor the normal hierarchy scenario against the inverted hierarchy scenario for the masses of the active neutrino species. © 2015 IOP Publishing Ltd and Sissa Medialab srl .</p> | 66       |



| Title   | Abstract   | Cited by |
|---|--|----------|
| THE WEAK LENSING SIGNAL and the CLUSTERING of BOSS GALAXIES. II. ASTROPHYSICAL and COSMOLOGICAL CONSTRAINTS | We perform a joint analysis of the abundance, the clustering, and the galaxy-galaxy lensing signal of galaxies measured from Data Release 11 of the Sloan Digital Sky Survey III Baryon Oscillation Spectroscopic Survey in our companion paper, Miyatake et al. The lensing signal was obtained by using the shape catalog of background galaxies from the Canada France Hawaii Telescope Legacy Survey, which was made publicly available by the CFHTLenS collaboration, with an area overlap of about $105 \text{ deg}^2$ . We analyze the data in the framework of the halo model in order to fit halo occupation parameters and cosmological parameters ( $\Omega$ and $h$ ) to these observables simultaneously, and thus break the degeneracy between galaxy bias and cosmology. Adopting a flat $\Lambda$ CDM cosmology with priors on $\Omega$ , $h$ , and $\sigma_8$ from the analysis of WMAP 9 yr data, we obtain constraints on the stellar mass-halo mass relation of galaxies in our sample. Marginalizing over the halo occupation distribution parameters and a number of other nuisance parameters in our model, we obtain $\Omega$ and $h$ (68% confidence). We demonstrate the robustness of our results with respect to sample selection and a variety of systematics such as the halo off-centering effect and possible incompleteness in our sample. Our constraints are consistent, complementary, and competitive with those obtained using other independent probes of these cosmological parameters. The cosmological analysis is the first of its kind to be performed at a redshift as high as 0.53. © 2015. The American Astronomical Society. All rights reserved.. | 62       |
| Integration of Digital Factory with Smart Factory Based on Internet of Things                               | Internet of things (IoT) in manufacturing can be defined as a future where every day physical objects in the shop floor, people and systems (things) are connected by the Internet to build services critical to the manufacturing. Smart factory is a way towards a factory-of-things, which is very much aligned with IoT. IoT not only deals with smart connections between physical objects but also with the interaction with different IT tools used within the digital factory. Data and information come from heterogeneous IT systems and from different domains, viewpoints, levels of granularity and life cycle phases causing potential inconsistencies in the data sharing, preventing interoperability. Hence, our aim is to investigate approaches and principles when integrating the digital factory, IT tools and IoT in manufacturing in a heterogeneous IT environment to ensure data consistency. In particular this paper suggests an approach to identify what, when and how information should be integrated. Secondly it suggests integration between IoT and PLM platforms using semantic web technologies and Open Services for Lifecycle Collaboration (OSLC) standard on tool interoperability.  | 59       |
| A sentiment analysis of U.S. local government tweets: The connection between tone and citizen involvement   | As social media tools become more popular at all levels of government, more research is needed to determine how the platforms can be used to create meaningful citizen-government collaboration. Many entities use the tools in one-way, push manners. The aim of this research is to determine if sentiment (tone) can positively influence citizen participation with government via social media. Using a systematic random sample of 125 U.S. cities, we found that positive sentiment is more likely to engender digital participation but this was not a perfect one-to-one relationship. Some cities that had an overall positive sentiment score and displayed a participatory style of social media use did not have positive citizen sentiment scores. We argue that positive tone is only one part of a successful social media interaction plan, and encourage social media managers to actively manage platforms to use activities that spur participation. © 2015 Elsevier Inc..   | 57       |
| Social media and protest mobilization: evidence from the Tunisian revolution                                | This article explores how social media acted as a catalyst for protest mobilization during the Tunisian revolution in late 2010 and early 2011. Using evidence from protests we argue that social media acted as an important resource for popular mobilization against the Ben Ali regime. Drawing on insights from “resource mobilization theory”, we show that social media (1) allowed a “digital elite” to break the national media blackout through brokering information for mainstream media; (2) provided a basis for intergroup collaboration for a large “cycle of protest”; (3) reported event magnitudes that raised the perception of success for potential free riders, and (4) provided additional “emotional mobilization” through depicting the worst atrocities associated with the regime's response to the protests. These findings are based on background talks with Tunisian bloggers and digital activists and a revealed preference survey conducted among a sample of Tunisian internet users (February–May 2012). © 2014 Taylor & Francis.   | 57       |

| Title  | Abstract   | Cited by |
|--|--|----------|
| Success & scale in a data-producing organization: The Socio-technical evolution of openstreetmap in response to humanitarian events  | OpenStreetMap (OSM) is a volunteer-driven, globally distributed organization whose members work to create a common digital map of the world. OSM embraces ideals of open data, and to that end innovates both socially and technically to develop practices and processes for coordinated operation. This paper provides a brief history of OSM and then, through quantitative and qualitative examination of the OSM database and other sites of articulation work, examines organizational growth through the lens of two catastrophes that spurred enormous humanitarian relief responses-the 2010 Haiti Earthquake and the 2013 Typhoon Yolanda. The temporally- And geographically- constrained events scope analysis for what is a rapidly maturing, whole-planet operation. The first disaster identified how OSM could support other organizations responding to the event. However, to achieve this, OSM has had to refine mechanisms of collaboration around map creation, which were tested again in Typhoon Yolanda. The transformation of work between these two events yields insights into the organizational development of large, data-producing online organizations. © Copyright 2015 ACM.  | 55       |
| Low-cost virtual reality environment for engineering and construction  | Background: Presenting significant building or engineering 3D-models is a crucial part of the planning, construction and maintenance phases in terms of collaboration and understanding. Especially in complex or large-scale models, immersion is one of the major key factors for being able to intuitively perceive all aspects of the scene. A fully immersive system needs to give the user a large field-of-view with reduced latency for lifelike impression. Technologies such as VRwalls and shutter glasses can deliver high refresh rates, yet fail to give a large field-of-view. Head-mounted-devices for virtual reality fill this gap. Head tracking mechanisms translate movements of the user's head into virtual camera movements and enable a natural way of examining models. Unlike a stereoscopic representation with projectors, point-of-view tracking can be achieved separately for each individual user. Hardware costs for such systems were very high in the past, but have dropped due to virtual reality systems now gaining traction in the mainstream gaming community. Methods: In this paper we present a way to build a low-cost, highly immersive virtual reality environment for engineering and construction applications. Furthermore, we present a method to simplify and partly automate the process of reusing digital building models, which are already used in construction, to create virtual scenes, instead of having to do parallel content creation for visualization. Using the Oculus Rift head-mounted display and the Leap Motion hand-tracking device, we show the possibilities of naturally interacting within a virtual space in different use cases. The software, based on the popular game engine Unreal Engine 4, will be used as a basis for further research and development. Results: Building Information Modeling data can be imported to UE4 with our presented plugin. Using an automated database for mapping materials to the geometry simplifies the process of importing Building Information Modeling entities. The refresh rate of the system stays within acceptable margins needed for virtual reality applications using head-mounted devices. Conclusions: Head-mounted devices present a great potential for the Architecture, Engineering and Construction industry, as a person can experience realistic first-person situations without having to care about injuries. Automated processes for the simplification of content creation, leveraging existing models, and the usage of visual programming languages enable even nonprogrammers to create scenarios to their needs. © 2016, Hilfert and König. | 53       |
| Review: Development of an in situ observation network for terrestrial ecological remote sensing: the Phenological Eyes Network (PEN) | The Phenological Eyes Network (PEN), which was established in 2003, is a network of long-term ground observation sites. The aim of the PEN is to validate terrestrial ecological remote sensing, with a particular focus on seasonal changes (phenology) in vegetation. There are three types of core sensors at PEN sites: an Automatic Digital Fish-eye Camera, a HemiSpherical SpectroRadiometer, and a Sun Photometer. As of 2014, there are approximately 30 PEN sites, among which many are also FluxNet and/or International Long Term Ecological Research sites. The PEN is now part of a biodiversity observation framework. Collaborations between remote sensing scientists and ecologists working on PEN data have produced various outcomes about remote sensing and long-term in situ monitoring of ecosystem features, such as phenology, gross primary production, and leaf area index. This article reviews the design concept and the outcomes of the PEN, and discusses its future strategy. © 2015, The Ecological Society of Japan.   | 53       |

| Title   | Abstract   | Cited by |
|---|--|----------|
| Early rectal cancer: the European Association for Endoscopic Surgery (EAES) clinical consensus conference | <p>Background: The last 30 years have witnessed a significant increase in the diagnosis of early-stage rectal cancer and the development of new strategies to reduce the treatment-related morbidity. Currently, there is no consensus on the definition of early rectal cancer (ERC), and the best management of ERC has not been yet defined. The European Association for Endoscopic Surgery in collaboration with the European Society of Coloproctology developed this consensus conference to provide recommendations on ERC diagnosis, staging and treatment based on the available evidence. Methods: A multidisciplinary group of experts selected on their clinical and scientific expertise was invited to critically review the literature and to formulate evidence-based recommendations by the Delphi method. Recommendations were discussed at the plenary session of the 14th World Congress of Endoscopic Surgery, Paris, 26 June 2014, and then posted on the EAES website for open discussion. Results: Tumour biopsy has a low accuracy. Digital rectal examination plays a key role in the pre-operative work-up. Magnification chromoendoscopy, endoscopic ultrasound and magnetic resonance imaging are complementary staging modalities. Endoscopic submucosal dissection and transanal endoscopic microsurgery are the two established approaches for local excision (LE) of selected ERC. The role of all organ-sparing approaches including neoadjuvant therapies followed by LE should be formally assessed by randomized controlled trials. Rectal resection and total mesorectal excision is indicated in the presence of unfavourable features at the pathological evaluation of the LE specimen. The laparoscopic approach has better short-term outcomes and similar oncologic results when compared with open surgery. Conclusions: The management of ERC should always be based on a multidisciplinary approach, aiming to increase the rate of organ-preserving procedures without jeopardizing survival. © 2015, Springer Science+Business Media New York.</p> | 51       |
| What's the difference? Learning collaboratively using iPads in conventional classrooms                    | <p>Since its release in 2010, Apple's iPad has attracted much attention as an affordable and flexible learning tool for all levels of education. A number of trials have been undertaken exploring the device's efficacy for specific purposes, such as improving delivery of course content and learning resources at tertiary level, and the performance of apps for meeting specialised learning needs. However, with increased mainstreaming of these devices through iPad-supported modern learning environment (MLE) and Bring Your Own Device (BYOD) programmes, data are becoming available that provides insight into how these devices function as part of regular classroom environments. This article reports an analysis of data collected over almost 3 years from nearly 100 New Zealand primary (elementary) students of different ages, who used iPads daily for most curriculum tasks. Specifically, it uses different data sources to explore how observed and recorded device design and app attributes, affected the students' ability to work collaboratively. Results suggest fundamental differences exist between iPads and other digital devices that helped these students collaborate, and that when combined with cloud-based apps and services such as Google Docs, extended this collaboration to much wider audiences well beyond the school gate. It concludes that beyond the hype and rhetoric, exciting potential exists for this tool to support a 'blurring in the line' between learning in formal school and informal environments. © 2015 Elsevier Ltd. All rights reserved.</p>  | 49       |

| Title   | Abstract   | Cited by |
|---|--|----------|
| Personalised digital interventions for reducing hazardous and harmful alcohol consumption in community-dwelling populations | This is the protocol for a review and there is no abstract. The objectives are as follows: The main objective is to assess the effectiveness and cost effectiveness of digital interventions for reducing hazardous and harmful alcohol consumption and/or alcohol-related problems in community-dwelling populations. We envisage two comparator groups: (1) no intervention (or minimal input) controls; and (2) another active intervention for delivering preventive advice or counselling to reduce hazardous or harmful alcohol consumption. Specifically, we will address two questions: (1) Are digital interventions superior to no intervention (or minimal input) controls? This question is important for individuals accessing interventions through their own motivation or interest. These individuals will be unlikely to experience active practitioner input and it is important to understand whether digital interventions are better than general material they might seek out on the internet or via mobile phone-based apps etc. (2) Are digital interventions at least equally effective as face-to-face brief alcohol interventions? Practitioner delivered brief interventions are generally accepted to be the best alternative in secondary preventive care in health, workplace, educational or community settings. However, time constraints can impede face-to-face delivery of such interventions and it is important to know whether digitally provided input can yield comparable effects to interventions delivered by trained practitioners. We will also identify the most effective component behaviour change techniques of such interventions and their mechanisms of action. Secondary objectives are as follows: To assess whether outcomes differ between trials where the digital intervention targets participants attending health, social care, education or other community-based settings and those where it is offered remotely via the internet or mobile phone platforms; To develop a taxonomy of interventions according to their mode of delivery (e.g. functionality features) and assess their impact on outcomes; To identify theories or models that have been used in the development and/or evaluation of the intervention - this will inform intervention development work. © 2015 The Cochrane Collaboration. | 47       |

Full data file on figshare: [Scopus-papers-titles-abstracts-by-cited-2015-2016.csv](#)

## OnePetro

Query for collaboration digital, published between 2015 and 2019 has returned 741 results.

### Using KH Coder 3

Tokens (in use) 249918 (125086); Types (in use) 14427 (13296); Sentences — 9352; Paragraphs — 741

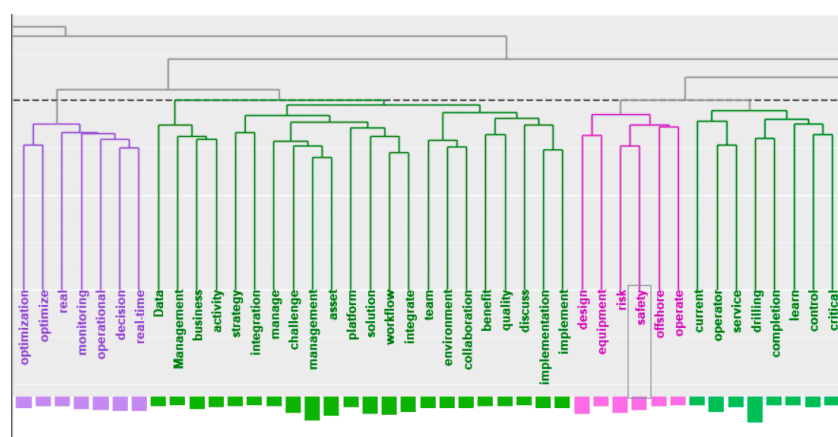
### TermExtract results

**Table 10.** Most scored key terms by KH Coder 3 from 741 docs in OnePetro

| Key Term                    | Score     | Key Term                     | Score    | Key Term                       | Score    |
|-----------------------------|-----------|------------------------------|----------|--------------------------------|----------|
| <b>gas industry</b>         | 31805.351 | drilling performance         | 3206.480 | gas operators                  | 1729.971 |
| <b>real-time data</b>       | 12697.189 | <b>integrated operations</b> | 3121.852 | field operations               | 1702.496 |
| oil production              | 11547.843 | digital data                 | 3046.968 | petroleum industry             | 1675.065 |
| <b>digital oil field</b>    | 10918.372 | gas companies                | 3040.133 | production surveillance        | 1648.005 |
| digital oilfield            | 8161.046  | <b>digital twin</b>          | 3024.676 | energy industry                | 1638.245 |
| <b>data management</b>      | 8077.377  | new technologies             | 2991.173 | <b>service companies</b>       | 1621.945 |
| big data                    | 7423.289  | <b>operational data</b>      | 2901.094 | upstream oil                   | 1607.986 |
| gas production              | 7385.725  | oil gas                      | 2889.708 | first time                     | 1603.787 |
| oil industry                | 6483.232  | field data                   | 2815.654 | <b>historical data</b>         | 1601.076 |
| field development           | 6176.364  | reservoir performance        | 2686.703 | natural gas                    | 1586.760 |
| real time                   | 6140.001  | drilling process             | 2684.241 | production management          | 1582.926 |
| <b>digital technology</b>   | 5817.222  | asset management             | 2615.884 | gas business                   | 1547.990 |
| production data             | 5548.740  | production system            | 2471.536 | offshore industry              | 1527.126 |
| <b>data analytics</b>       | 5119.965  | <b>offshore operations</b>   | 2296.944 | gas sector                     | 1518.857 |
| <b>reservoir management</b> | 5074.332  | field production             | 2207.138 | <b>operational performance</b> | 1476.884 |
| digital transformation      | 4879.532  | digital field                | 2121.002 | work process                   | 1446.400 |
| <b>gas operations</b>       | 4557.637  | <b>process safety</b>        | 2065.147 | <b>design process</b>          | 1439.003 |
| oil gas industry            | 4438.945  | operational efficiency       | 1936.433 | <b>production network</b>      | 1420.280 |

| Key Term                   | Score    | Key Term                     | Score    | Key Term                      | Score    |
|----------------------------|----------|------------------------------|----------|-------------------------------|----------|
| case study                 | 4297.686 | <b>production operations</b> | 1917.181 | production efficiency         | 1410.931 |
| <b>oil recovery</b>        | 4233.708 | <b>drilling data</b>         | 1889.580 | reservoir production          | 1378.999 |
| <b>seismic data</b>        | 4210.905 | water production             | 1888.209 | production facility           | 1369.539 |
| <b>offshore oil</b>        | 4200.998 | <b>data integration</b>      | 1872.286 | digital oil fields            | 1351.149 |
| real time data             | 4160.349 | <b>big data analytics</b>    | 1859.032 | <b>data acquisition</b>       | 1316.907 |
| digital technologies       | 4015.472 | new approach                 | 1821.174 | <b>integrated asset model</b> | 1315.313 |
| new technology             | 3811.716 | reservoir engineering        | 1790.921 | petroleum engineering         | 1311.035 |
| <b>data quality</b>        | 3755.329 | asset performance            | 1778.310 | data analysis                 | 1276.861 |
| <b>drilling operations</b> | 3656.134 | <b>risk management</b>       | 1764.876 | information technology        | 1275.513 |
| production optimization    | 3520.378 | engineering data             | 1764.785 | digital solutions             | 1221.644 |
| oil field                  | 3238.333 | technology development       | 1764.559 | new system                    | 1179.485 |
| production performance     | 3228.277 | drilling industry            | 1755.566 | operational excellence        | 1146.519 |

**Remark:** Score — as derived by KH Coder 3. Using the terms highlighted in the table, we get a detailed context within which digital collaboration in the petroleum industry takes place. See more information in the file — [OnePetro\\_all-titles-abstracts\\_TermExtract\\_results.tsv\(13.52 kB\)](#).



**Figure 3.** fragment of hierarchical clustering of words from titles and abstracts of 741 OnePetro documents. For more data see the file — [OnePetro\\_all-titles-abstracts\\_hierarchical-clustering\\_results.png](#)

## Some claims on collaboration in digital ages

Transformation allows an organization to redesign its ways of providing a service; collaboration creates an environment where working together is the norm, and innovation means that we can really make a difference in people's lives.

<https://www.openaccessgovernment.org/digital-transformation-2/51888/>

Champions of Collaboration Lead the Digital Transformation Workplace innovation is born from collaboration Innovation is more necessary than ever in the current highly competitive and global environment. In this regard, well-handled digitalization of the workforce has a remarkable impact on business productivity, collaboration and innovation. A collaborative workspace is more capable of adapting to new market dynamics and driving innovation. <https://partner.microsoft.com/en-ie/training/champions-collaboration-digital-transformation>

The role of collaboration in digital transformation If you want to change your company, getting people together is an important part of the process To make digital transformation a success, collaboration is necessary. According to research by electronics manufacturer Sharp, almost half of the people it surveyed (46%) said their colleagues had forgotten to share important information or documents with them. <https://www.itpro.co.uk/collaboration-software/28797/the-role-of-collaboration-in-digital-transformation>

How collaboration apps foster digital transformation Throughout enterprises large and small, collaboration apps and services are breaking down silos, connecting colleagues in more effective ways and resulting in stronger employee engagement. These tools are enabling companies to transition to a purely digital world and transform business operations with relative ease.

<https://www.computerworld.com/article/3332213/collaboration/how-collaboration-apps-foster-digital-transformation.html>

How to handle digital transformation and collaboration at large enterprises Collaboration tools should be unobtrusive. They need to bring the right people together with the right information, and empower them to collaborate effectively. Put simply: A business with great collaboration tools is a business that spends no time worrying about those tools. But how do you get there?

<https://www.enterprise-cio.com/news/2018/may/22/how-handle-digital-transformation-and-collaboration-large-enterprises/>

Collaborative Intelligence: Humans and AI Are Joining Forces

In our research involving 1,500 companies, we found that firms achieve the most significant performance improvements when humans and machines work together. Through such collaborative intelligence, humans and AI actively enhance each other's complementary strengths: the leadership, teamwork, creativity, and social skills of the former, and the speed, scalability, and quantitative capabilities of the latter. <https://hbr.org/2018/07/collaborative-intelligence-humans-and-ai-are-joining-forces>

A new wave of intelligent collaboration In the past, people have had to adapt to collaborative tools, but emerging technology makes it possible for technology to adapt to people. <https://www.computerworld.com/future-of-teamwork/playlist/the-future-of-teamwork/Article/how-ai-cognitive-technology-are-transforming-collaboration>

collaboration is critical for any organization to succeed. Businesses need to interact efficiently with both internal and external parties and constituents. The most effective way to nurture a collaborative workplace is to foster a culture in which collaboration and engagement are respected and rewarded.

What I've referred to as "Intelligent collaboration," is really about the application of intelligence to collaborative interactions to achieve deeper insights that produce better decision-making at all points in the process. <https://www.cio.com/article/3201001/artificial-intelligence/the-growing-impact-of-artificial-intelligence-on-workplace-collaboration.html>

Collaborative intelligence characterizes multi-agent, distributed systems where each agent, human, or machine is uniquely positioned with autonomy to contribute to a problem-solving network. Collaborative autonomy of organisms in their ecosystems makes evolution possible. Natural ecosystems, where each organism's unique signature is derived from its genetics, circumstances, behavior and position in its ecosystem, offer principles for design of next generation social networks to support collaborative intelligence, crowd-sourcing individual expertise, preferences, and unique contributions in a problem-solving process. [https://en.wikipedia.org/wiki/Collaborative\\_intelligence](https://en.wikipedia.org/wiki/Collaborative_intelligence)

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- KH Coder 3: for Quantitative Content Analysis or Text Mining <http://khcoder.net/en>
- Direct link to figshare data: <https://figshare.com/s/1c00aa1f75f886eaa083>

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