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A Review of Research Methods in ISPIM Publications

Teemu Santonen*

Laurea University of Applied Sciences,
Vanha maaantie 9, O2650 Espoo, Finland.
E-mail: teemu.santonen@laurea.fi

Marcus Tynnhammar, Steffen Conn

ISPIM
PO Box 18, Worsley, Manchester M28 1XP
E-mail: tynnhammar@ispim.org, conn@ispim.org

* Corresponding author

Abstract: Scientific research is a systematic effort to discover new knowledge. A research methodology defines the overall strategy to execute research actions and justifies why certain kinds of research methods are used to resolve the defined research question(s). Research methods can be considered to be tools or series of techniques, which are needed to accomplish the goals of the research. However, what kind of research methods are popular among the innovation scholars and how these research methods have evolved overtime is not well understood. A research method typology derived from the social sciences was applied to investigate what kind of research methods are popular within the ISPIM innovation community. Results from 3148 ISPIM publications from 2003 to 2017 are presented and research method gaps are identified.

Keywords: Research method, Research methodology, Scientometrics, Comparative research, Social Science, ISPIM, typology, taxonomy

1. Introduction

Science by definition builds on previous knowledge, which evolves over time, further refining and developing the knowledge and serving as a foundation for further research. Thus, an in-depth understanding of the structure and foundations of the scientific knowledge in any research domain, including innovation management, is vital. However, the current status and evolution of the research methods and methodologies in the innovation management domain are not well understood. As a result we do not know what kind of research methods have been applied and how the methodological strategies differ between researchers and various research streams. Therefore, this study reveals how researchers in the innovation management community have applied research methods in their research, while executing their methodological strategies.

Scientific conference proceedings as a relevant and important knowledge source have been recognized but also criticized (Lisée, et al. 2008; Drott 1995). Many authors argue that conference proceedings and journal articles can be considered as complimentary communication channels (González-Albo and Bordons, 2011; Butler and Visser 2006). On the other hand, Montesi and Mackenzie (2008) suggested that conference proceedings can demonstrate an ability to innovate and propose new ideas. Since ISPIM is among the leading innovation management research communities (Bourdieu, 2004; Baregheh et al. 2009), we argue that ISPIM proceedings can be a good platform to identify and evaluate what kind of research methods have been applied in innovation management studies. By selecting ISPIM publications as an information source, there is a possibility to reveal novel insights that studies focusing on journal publications might omit.

Prior studies analysing the ISPIM community have revealed e.g. 1) the co-authorships relations between the various ISPIM scholars (Santonen and Ritala, 2014), 2) identified (Santonen and Conn, 2015a) TOP50 ISPIM research topics, 3) by using social network analysis methods investigated how the different ISPIM research topics are linked with each other (Santonen and Conn, 2016) and finally 4) evaluated how the ISPIM research topics have evolved over time (Santonen and Conn, 2015b). Even if the above studies have provided a relatively good understanding about the composition of ISPIM authors and research topics, there is a clear research gap relating to research methods. Thus, the goal of this submission is to review the kinds of research methods that ISPIM publications are grounded in and to identify what kind of evolution the research methods are following.

2. Research Methods in Innovation Management

Scientific research refers to a systematized effort and careful investigation to search for and to generate new knowledge, whereas research methods can be defined as different kinds of procedures and methods that researchers use to perform research operations (Kothari, 2004). Research methods should not to be confused with research methodologies, which have a wider scope. Methodology includes also the logic and underlying assumptions behind the methods and justifies why certain methods have been selected to study the given problem. This study mainly focuses on method level analysis.

Giving a clear definition for innovation management is not clear cut, since depending on the viewpoint it can be associated with multiple other research domains such as management, organizational science, marketing and the social sciences. Currently there are no studies that have empirically evaluated solely innovation management research methods or methodologies. However, in other related domains a few studies focusing partially or fully on method and methodological evaluations do existing. Among these are, for example, the following studies in which we have highlighted the keywords to be used as search words.

Case studies. A study by Hitt et al. (1998) argued that early work in strategic management was strongly grounded on single case studies which then evolved to using secondary data from large multi-industry firm samples and later to focusing on the resource based view using smaller sample studies. Therefore it is expected that that within ISPIM research community, *"case studies"* are among the most popular methods.

Empirical vs. non-empirical studies. Understanding the division between empirical and non-empirical (e.g. conceptual or theory building) studies has also been one of the aims of the studies evaluating research methods. Ketchen et al. (2008) identified significant

growth in the use of *"empirical methods"*, *"sample size"*, usage of *"cross-sectional design"*, as well as the switch from basic *"descriptive analysis"* to currently dominant *"regression"* and *"ANOVA"* models in Strategic Management Journal publications. Yoo et al. (2010) hospitality marketing research evaluation suggested that most of the studies in this field were empirical studies grounded on *"survey"* data and descriptive data analysis while *"mixed methods"* studies were rare. Therefore, it is also argued that similar phenomenon could also take place within the ISPIM community.

Validity, reliability, bias and triangulation. Scandura and Williams (2000) conducted a content analysis in order to evaluate the use of research methods to address *"triangulation"* and *"validity"* which are an essential part of any research. Harrison et al. (2017) focused on publication bias and found evidence that some topic areas in strategic management research suffer from it whereas others are robust to its effects. Triangulation can take many forms (Denzin, 1970) but in this study we focus on methodological triangulation – using multiple *"quantitative"* or *"qualitative"* methods or combining them.

Longitudinal studies. Uygun and Altın, (2011) continued their work and suggested that *"longitudinal data"* obtained from archival sources have been used more frequently than previously. Longitudinal studies are important tools when trying to understand the evolution of any research topic. Since innovation, by definition, is always grounded in something new, it is interesting to evaluate whether longitudinal studies, in general, have gained interest among innovation management scholars.

Most typical tools. By utilizing textual narrative synthesis method Qehaja et al (2017) identified the following ten most used strategic management tools and techniques worldwide: *"SWOT analysis"*, *"benchmarking"*, *"PEST analysis"*, "what if" analysis, *"vision"* and *"mission"* statements, *"Porter's five forces analysis"*, *"business financial analysis"*, *"key success factors analysis"*, *"cost‑benefit analysis"* and *"customer satisfaction"*.

Typologies. Beissel-Durrant (2004) developed and Luff et. al (2015) reviewed and updated a typology of research methods in social science, which included the following categories: 1) Frameworks for Research and Research Designs, 2) Data Collection, 3) Data Quality and Data Management, 4) Qualitative Data Handling and Data Analysis, 5) Quantitative Data Handling and Data Analysis, 6) Mixed Methods Data Handling and Data Analysis, 7) ICT, Software and Simulation, 8) Research Management and Impact, and 9) Research Skills, Communication and Dissemination. Within each main category, a group of subcategories were defined, which will be used also as a search term.

To sum up, it is argued that there is a genuine need to empirically evaluate the current state and evolution of innovation management research methods, since there appears to be a clear research gap.

3 Research methodology

A comprehensive scientometrics evaluation framework as suggested by Santonen and Conn (2015), was applied in order to identify the absolute and relative popularity of the different research methods within the ISPIM research community. In practice, the frequencies of different research methods were calculated by summing up how many times the particular search term (i.e. research method) was existing in an individual ISPIM publication. On the basis of the search process results, ISPIM PUBLICATION x RESEARCH METHOD matrix in which 3148 ISPIM publications from year 2003 to year

2017 were represented as rows and 474 different research methods as defined in the social science taxonomy were presented as columns (Beissel-Durrant, 2004; Luff et. al 2015). An additional YEAR column was added to the matrix in order to be able to identify the evolution of the research methods. Compared to the original taxonomy lists, also plural and singular words (e.g. study vs studies) were added to the list in order to identify the most common spelling variations. A few combined words were also split to control for spelling variations. The distribution of the number of ISPIM publications is presented in Table 1.

Table 1: Distribution of the number of ISPIM publications

YEAR	Number of publications	YEAR	Number of publications
2003	25	2011	253
2004	39	2012	344
2005	71	2013	333
2006	73	2014	345
2007	86	2015	297
2008	188	2016	301
2009	279	2017	271
2010	243		

Since some of the search words in the taxonomy list are also common words without unambiguous connection to research methods (e.g. technology), the interpretation of these result is somewhat problematic especially if they generate a substantial number of search results. Therefore, to control the coverage and impact of the search words, the following two indicator measures were defined for each search word: 1) COVERAGE = Number of publications including the search word and 2) IMPACT = How many times the word appeared in the search results. Based on these the AVERAGE OCCURANCE of the each search word was calculated.

Importantly, since the search was targeted at whole papers, the collected data is not fully able to verify if the particular study was applying the method or was only referring it to (e.g. in the literature review section). Therefore the interpretation of the results can be somewhat biased. However, it is argued that our research methods search approach is still valid for our research purposes, since all the references in the publication should be relevant for that particular study. Thus, even if there is no direct linkage to the identified research method, there is at least an indirect linkage. Indirect links are also important, since by definition, science builds on previous knowledge and the ISPIM author(s) did consider them as relevant to the research method.

4 Results

4.1 The Average Occurrence of the Research Methods

In all 196 out of 474 search words (41.4%), which were included in the taxonomy, appeared in no search results. Thus, they were omitted from further analysis. The average

occurrence, as a control variable, revealed that 90 words (18.7%) only got one hit. COVERAGE and IMPACT measures were used to detect higher outliers in order to control the data collection bias. As a result "Technology (COVERAGE = 2779, IMPACT = 46452)", "Framework (2132, 10845),", "Survey (1468, 6868)", "Integration (1448, 6372)" and "Evaluation (1442, 6234)" search words were found to be higher outliers. Therefore, outliers excluding "Survey", which is evidently referring to a certain kind of research method, were omitted from further analysis as well as those words which did not gain any hits. After this filtering process, 278 different search words remained for analysis.

4.2 The Most Popular Research Method Class

In the Table 2, popularity according to COVERAGE mean value is compared between the nine main categories. Also the maximum and standard deviation values are presented.

Table 2: Popularity of main research methods according to social science taxonomy

Taxonomy category	Max	Mean	Std.Dev.
1. Data Collection	7	1.19	1.260
2. Frameworks for Research and Research Designs	6	.99	.994
3. Quantitative Data Handling and Data Analysis	8	.78	1.136
4. Research Management and Impact	4	.67	.800
5. Data Quality and Data Management	6	.65	.960
6. ICT, Software and Simulation	4	.40	.607
7. Mixed Methods Data Handling and Data Analysis	3	.33	.517
8. Research Skills, Communication and Dissemination.	3	.21	.442
9. Qualitative Data Handling and Data Analysis	4	.14	.405
Quantitative, Mixed Methods and Qualitative Data Handling and Data Analysis	9	1.25	1.343
Different taxonomy classes per publication	9	3.55	1.894
Different research method variables total	21	5.37	3.484

According to Kolmogorov-Smirnov and Shapiro-Wilk tests, all our taxonomy variables violated the normal distribution assumption. Therefore a non-parametric Friedman test was carried out to compare whether the popularity differences between the taxonomies were significant. As a result all but the following taxonomies' popularities differed significantly when the nine taxonomy variables were included in the analysis. 1) "Data Collection" vs. "Frameworks for Research and Research Designs", 2) "Quantitative Data Handling and Data Analysis" vs. "Data Quality and Data Management", 3) "Quantitative Data Handling and Data Analysis" vs. "Research Management and Impact" and 4) "ICT, software and simulation" vs." mixed methods data handing/analysis".

As a result, the two most common research method taxonomies are the "Data collection" with a mean value of 1.19 and "Frameworks for Research and Research Designs" with a mean value of 0.99. However, if all three Data Handling and Data Analysis taxonomies (i.e. quantitative, mixed methods and qualitative) are summed, their mean value is 1.25 and thus the most popular. The non-parametric Friedman test revealed no

significant difference between the "summed Data Handling and Data Analysis taxonomies" and "Data Collection" variables. The quantitative taxonomy with a mean of 0.78 is the most popular data handling/analysis method, while "mixed methods" with 0.33 is second and "qualitative methods" took the last position with a 0.14 mean value. On average ISPIM publications include 3.55 different research taxonomy classes and 5.37 different research method variables.

4.3 Evolution of Research Method at the Taxonomy Level

In Figure 1, the evolution of the following three most popular research method taxonomies is presented on the basis of their annual relative share: 1) Quantitative, Mixed Methods and Qualitative Data Handling and Data Analysis presented as a summary variable, 2) Data collection and 3) Frameworks for Research and Research Designs.
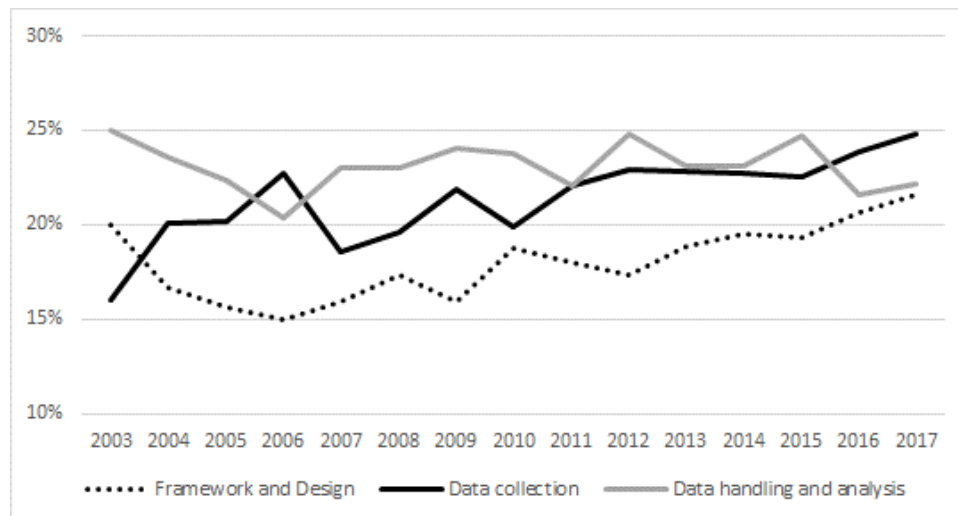

Figure 1: Evolution of the most popular research method taxonomy

Additionally, a correlation analysis between research method taxonomies and year was conducted to evaluate if there are any clear positive or negative trends. As a result "Frameworks for Research and Research Designs" (0.663**) and Data collection (0.808**) both positive growth trends. Trends were not detected in the case of the combined data handing variable.

In order to verify that the combined data handing variable did not mask any contrasting trends, the evolution of the Quantitative, Mixed Methods and Qualitative Data Handling and Data Analysis taxonomy classes were individually compared. The evolution trends are presented in the Figure 2.
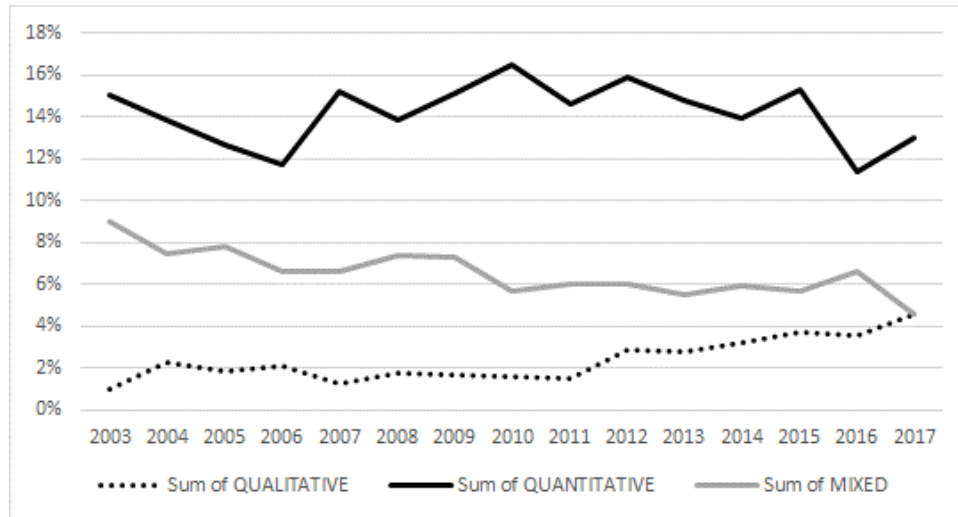
Figure 2: Evolution of the Quantitative, Mixed methods and
Qualitative data handing and analysis research methods

As a result, two opposite trends between Qualitative (0.820**) and Mixed methods (-0.813**) were detected. The relative share of the Quantitative data handing and analysis research methods remained static and was the most popular among the three alternatives. Evolution of the remaining taxonomy classes is presented in Figure 3.
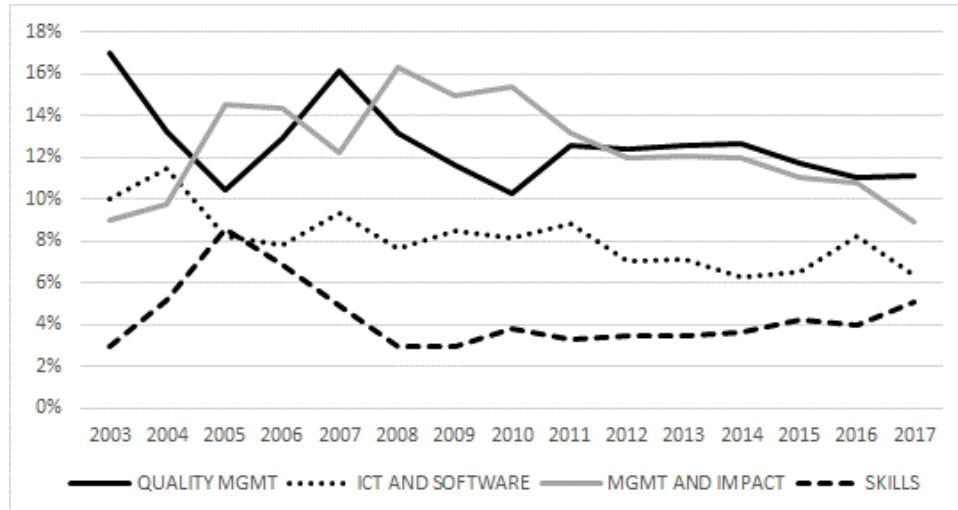

Figure 3: Evolution of the remaining taxonomy classes

Correlation analysis revealed negative trend (-0.752**) for ICT and Software taxonomy class. However, "Data Quality and Data Management" class marginally (-0.512, sig. 0.051) remained insignificant.

In the following, more in-depth analysis for each taxonomy class is conducted in order to control for the impact of opposite trends on the main trends.

4.4 Taxonomy 1: Frameworks for Research and Research Designs

In the case of "Frameworks for Research and Research Designs" research methods the following trends were observed. Forecasting (0.786**), Interdisciplinary (0.808**), Systematic review (0.905**), Mixed methods (0.895**), Online questionnaire (0.831**), Epistemology (-0.539*), User engagement (0.568*), Descriptive research (0.536*), Big data analysis (0.627*) and Panel survey (0.554*). A case study with 3.45 percent relative share in 2017 was the most popular research method within this taxonomy class. In Figure 4 the next most popular methods trends are presented. "Forecasting" gained second position after "case study" with a 1.2 percent relative share.
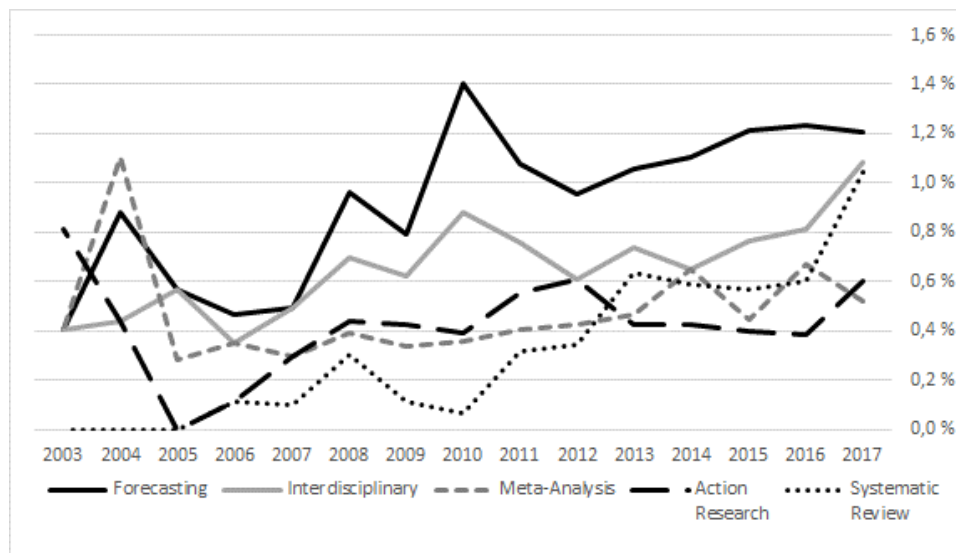

Figure 4: Evolution of the popular individual Research designs Methods (excluding Case study)

4.5 Taxonomy 2: Data Collection

In the case of "Data collection" the following trends were observed. Qualitative (0.800**), Observations (0.728**), structured interviews (764**), Sampling (0.560*), Semi-structured interviews (0.890**), Focus groups (0.580*), Big data (0.850**) and Qualitative comparative analysis (0.767**).

Evolution of the most popular data collection methods are presented in Figure 5. Qualitative search words had the greatest popularity with a 3.73 percent relative share in 2017. However, if "observation" with 2.45 percent share and "observations" with 1.37 share are summed together, the resulting 3.82 percent share makes "observation(s)" the most popular research method. This highlights the influence on the results. "Structured interviews" remained in fourth position with a 1.16 percent share. The research method search words in this particular taxonomy included multiple types of interviews. Therefore some might consider a need to sum them as one "Interview" method and not only rely on the more popular "Structured interviews". The following interview methods also gained in popularity: 1) Semi-structured interviews (1.0 percent in 2017), 2) Interviewing (0.6 percent), 3) Unstructured interviews (0.04 percent), and 4) Qualitative Interviewing (0.04

percent). Together the different interview spelling variations had a 2.85 percent relative share. On the other hand, the following interview methods did not gain in popularity: 1) Qualitative interview design, 2) Face-to-face qualitative interviewing, 3) Email/online qualitative interviews, 4) Self-interviews, 5) Walking interviews, 6) video call interviewing, 7) Videoing interviews, 8) Face-to-face survey interview and 9) Recording interviews.
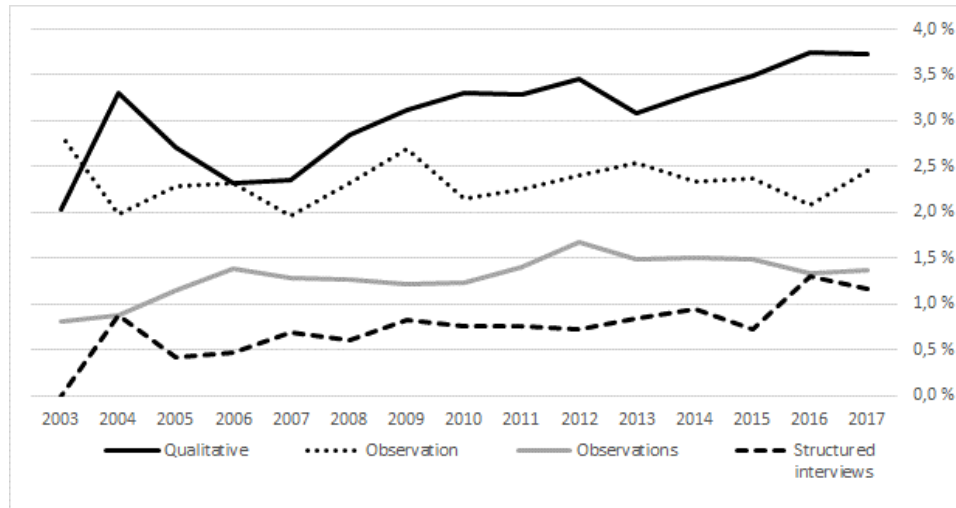

Figure 5: Evolution of the most popular data collection methods.

4.6 Taxonomy 3: Data Quality and Data Management

In the case of "Data Quality and Data Management" research methods the following trends were observed. Reflexivity (0.563*), Encryption (-0.585*) and Satisficing (-0.564*). The most common research methods in this particular taxonomy category are Reliability with 1.41 percent share in 2017 and Validity with 1.29 percent share. Transparency with 0.60 percent share remained third and Information management with a 0.36 share was the fourth.

4.7 Taxonomy 4, 5, and 6: Data Handling and Data Analysis

In the case of "Quantitative Data Handling and Data Analysis" research methods the following trends were observed. Effect size (0.794**), Principal component analysis (-0.528*), Ordinal regression (0.626*), Parametric statistics (0.515*) and Multilevel models (0.549*). However, all of these methods popularity was extremely small and remained below 0.1 percent. In the Figure 6, the evolution of the most popular Quantitative methods are presented.

Correlation with 1.33 percent share (year 2017) is the most popular quantitative method. Simulation with 0.88 percent share (2017) was the second most popular method. Factor analysis (0.16%) has lost its' third position to ANOVA (0.22%), but both of these popularities are modest. In the case of "Qualitative Data Handling and Data Analysis" research methods the following trends were observed. Content analysis (0.758**), Ethnography (0.823**), Thematic analysis (0.705**), Discourse analysis (0.742**), Interaction analysis (0.552*),

Content analysis with 0.76 percent share (year 2017) was the most popular and Grounded theory, with 0.44 percent share (year 2017), the runner up. The remaining methods' popularity was small, below 0.24 percent (year 2017).
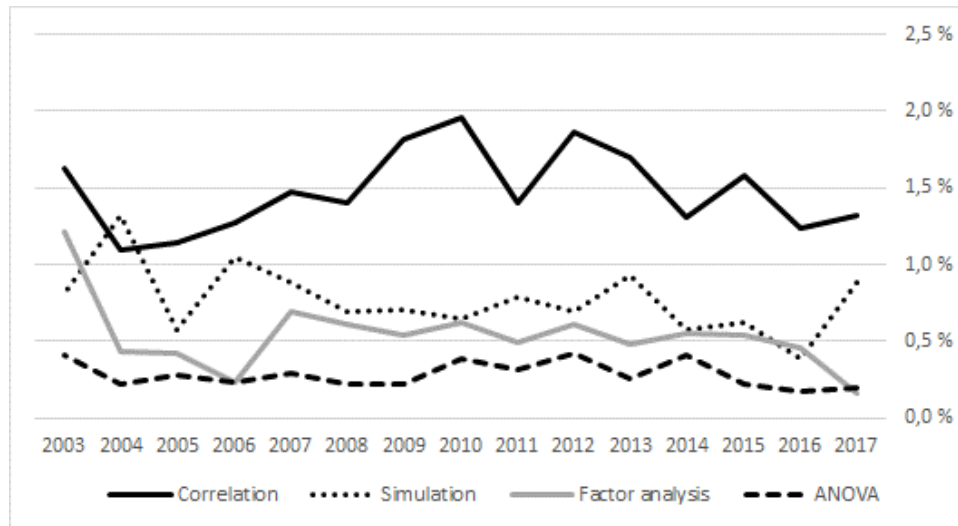

Figure 6: Evolution of the most popular Quantitative methods

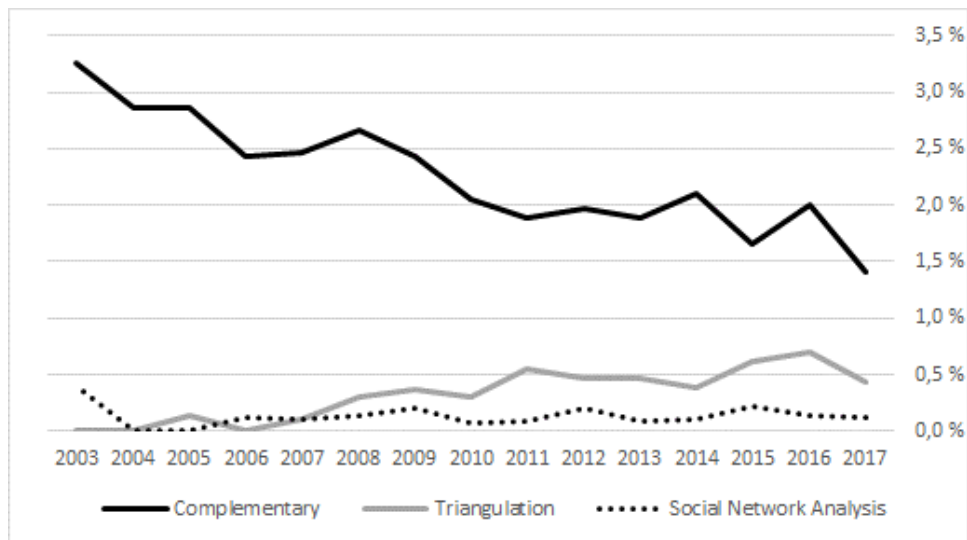In the Figure 7, the evolution of the most popular mixed methods are presented.

Figure 7: Evolution of the Mixed methods

The following two opposite trends are observed. Complementary is showing a clear declining trend (-0.921**), but still remains the most often named mixed method. On the contrary, Triangulation (0.890**), shows almost as strong growth trend although is

substantially less popular than the top ranking Complementary. The third ranking Social network analysis method, gains substantially fewer hits.

4.8 Taxonomy 7: ICT, Software and Simulation

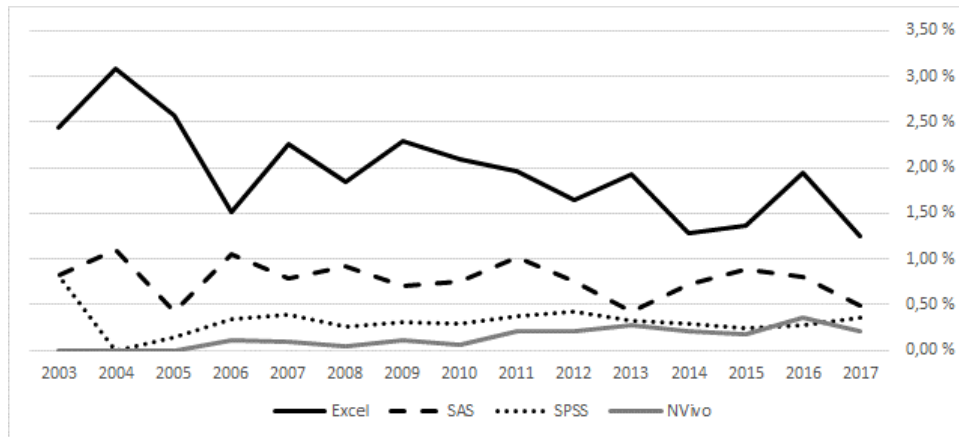In the Figure 8, the evolution of the most popular software solutions are presented.

Figure 8: Evolution of the ICT and software

As a result, "Excel" is showing a clear declining trend (-0.740**), but still remains the most often named software solution. The reduction of importance of Excel, which analysis possibilities are more limited than the higher-end Statistical Analysis Software, suggest the emergence of the more complex dataset and analysis methods. Statistical software solutions SAS and SPSS have steadily kept their second and third position over the years. NVivo which is helping to gain richer insights from qualitative and mixed-methods data is the fourth most popular software solution. Interestingly, NVivo (0.857**) as well as MAXQDA (0.744**) are showing clear positive trends. This observation suggests mixed methods and studies grounded on more complex qualitative data is becoming more popular among innovation scholars. The popularity of the other remaining software solutions remains relatively small scale. A final remark is made relating statistical software R, which was omitted from analysis due the high risk of data collection bias.

4.9 Taxonomy 8: Research Management and Impact

In the Figure 9, the evolution of the "Research Management and Impact" methods are presented. As a result, the following trends were identified. Research policy is showing a positive growth trend (0.588*) and is clearly the most popular research method within this taxonomy category. Change management (-0.596*) and copyright (-0.590*) are on the other hand indicating negative growth trends, whereas Research ethics is showing 0.651** growth trend.
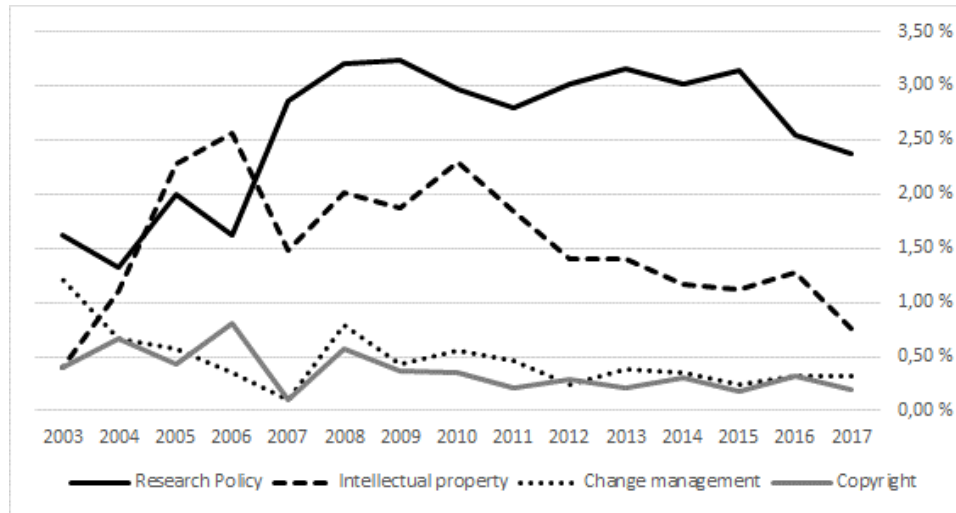
Figure 9: The evolution of the "Research Management and Impact" methods

4.10 Taxonomy 9: Research Skills, Communication and Dissemination

The "Literature reviews" method with a relative share in the year 2017 was modest (0.36 %), had the only positive growth trend (0.549*) in "Research Skills, Communication and Dissemination" taxonomy class. Clearly the most popular method was workshops with a relative share in year 2017 of 1.57 percent. Again, the other research methods had very modest popularity.

5 Conclusions

Scientific research is by definition grounded on systematic efforts to uncover new knowledge, in which research methodology defines and justifies the overall strategy to execute research actions via diverse sets of research methods. Based on a literature review, it was evident that currently it is relatively blurry as to what kinds of research methods innovation scholars have applied and how their methodological priorities have evolved over time. Therefore the ISPIM innovation research community publications from 2003 to 2017 were classified according to social science research method taxonomy in order to reveal how the nine different main research method categories were emphasized by ISPIM authors.

In all, slightly more than 40 percent of the search words did not appear in the search results and nearly 20 percent received only one hit. The most common research method taxonomies were related to "Data Handling and Data Analysis", "Data collection" and "Frameworks for Research and Research Designs". The more in-depth analysis revealed that quantitative methods were outperforming mixed methods and qualitative methods.

The evolution of the nine taxonomy classes revealed a mixed set of positive trends (i.e. "Frameworks for Research and Research Designs", "Data collection", "Qualitative data handing and analysis") and negative trends (i.e. "Mixed methods" and "ICT and Software taxonomy"). It was also observed that the individual research methods included in the nine main taxonomies, were going in opposite directions. A preliminary correlation analysis

was conducted to investigate the internal linkage between the different research methods. It revealed that there are multiple connections between various research methods. To understand these complex relationships, further studies are needed. The follow-up studies require careful planning and more comprehensive controlling of "stemming" words. Studies grounded on computer executed search algorithms are always bias sensitive. The manual coding performed by seasoned researchers would increase the reliability of these results. However, it is very labour intensive process and thus out of reach if the aim is to study the innovation management research domain as a whole.

In all we argue that this study helps to understand the innovation management research domain from the research method point of view. Innovation management scholars, practitioners, journal editors, teachers and conference organizers will have now a more solid understanding what kind of research methods have been and are currently mainstream in the innovation management domain. This information helps to identify and prioritize the need for methodological training and expose research gaps and plan future research projects.

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