Research methods for production engineering: Sherlock Holmes investigations

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Abstract: The purpose of this research is to identify "clues" to recommendations of useful research methods for Production Engineering reported as research methods used by the character Sherlock Holmes. The research is qualitative, exploratory and descriptive, and consists of the bibliographical consultation to the canon of narrative works of Sir Arthur Conan Doyle, carried out by the famous detective (four novels and five books with 56 stories). The results of this research are illustrative excerpts of methods used by Sherlock Holmes, and the data analysis matches them with methods recommended in articles and recognized textbooks of the area of Methods of Research in Production Engineering. This panorama offers broad potential to complement and assist the teaching-learning process, presenting another look at research methodologies and reinforcing the importance of methodological rigor in the use of data collection and analysis techniques in Production Engineering.

Keywords: Research methods; production engineering; Sherlock Holmes.

Título: Métodos de pesquisa para engenharia de produção: Investigações de Sherlock Holmes

Resumo: O objetivo desta pesquisa é identificar "pistas" de recomendações de métodos de pesquisa úteis para Engenharia de Produção relatados como métodos de investigação utilizados pelo personagem Sherlock Holmes. A pesquisa é qualitativa, exploratória e descritiva, e consiste na consulta bibliográfica ao cânone de obras narrativas de Sir Arthur Conan Doyle, protagonizadas pelo célebre detetive (quatro romances e cinco livros com 56 contos). Os resultados desta pesquisa são trechos ilustrativos de métodos utilizados por Sherlock Holmes, e a análise de dados os coteja com métodos recomendados em artigos e livros-textos reconhecidos da área de Métodos de Pesquisa em Engenharia de Produção. Este panorama oferece amplo potencial para complementar e auxiliar o processo de ensino-aprendizagem, apresentando outro olhar sobre metodologias de pesquisa e reforçando a importância do rigor metodológico no uso de técnicas de coleta e análise de dados em Engenharia de Produção.

Palavras-chave: Métodos de pesquisa; engenharia de produção; Sherlock Holmes.

Introduction

Concerning the present and future of Production Engineering, for the purpose of development and application of research in the Production Engineering field of knowledge, as well as for the maturity of the area as science itself, a relevant research topic is the challenges of teaching and learning Research Methods. The major scientific events in the area (e.g. Encontro Nacional de Engenharia de Produção – ENEGEP) devote specific topics of interest to Quantitative and Qualitative Research Strategies and Methods (Abepro, 2019).

It is possible to perceive the potential contribution of approaches from other areas of knowledge, such as the human and social sciences, and the possible relationships of some issues of Production Engineering, specially Management, with the Arts, including Literature (Pinheiro & Vieira, 2008). These areas have the potential to offer useful links to the understanding of different topics related to research methods. The contact between different areas of knowledge can overcome the stereotypes around the fields of knowledge and expand their possibilities of exercise, besides providing valuable support for the teaching-learning process (Alves, 2007).

Some scientific articles published by teachers in the areas of Production Engineering and Organizational Studies report initiatives in using literary works as a teaching tool and as an auxiliary activity to complement the understanding of certain topics (Pinheiro & Vieira, 2008, Malanovicz, 2016). Following this example, the use of Research Methods is explored, emphasized by the existence of many narratives present in works of Literature (especially of police literature) that immediately refer to situations commonly recognized as use of investigative methods. The process of investigation done by detectives in police literature can be interpreted as applications of research methods important to science teaching. That explains why studying the subject of narratives such as Sherlock Holmes ones are relevant to the field of Production Engineering, and it clarifies how this relates to research methods in Production Engineering. The focus here is on the narratives of Sir Arthur Conan Doyle (1859-1930) whose protagonist is Sherlock Holmes.

Purpose of this research

The purpose of this research is therefore to identify "clues" to recommendations of research methods useful for Production Engineering reported as research methods used by the character Sherlock Holmes. This paper is structured as follows. A reference is presented including research methods in Production Engineering, connections between Literature and Research Methodology, and the context of Sherlock Holmes stories. Next, the Method used in this work is presented, as well as the Results of the research, followed by a Discussion of them, and the Conclusions section.

Reference: Research methods, literature and Sherlock Holmes

Scientific Research Methods useful for Production Engineering can be identified in reference works of Research Methodology offered by Graduate Programs in Production Engineering. For this reason, the brief exposition that follows is based on the bibliography, full of "classic" works, of the

teaching plans of these courses (UFRGS), such as Qualitative Methods and Qualitative Research.

Elaboration and composition of theoretical essays (Sutton & Staw, 2003): defense of theoretical arguments that develop science in this area of knowledge;

Survey research (Freitas, Oliveira, Saccol, Moscarola, 2000, Hair, Babin, Money, Samouel, 2005, Malhotra, 2006): questionnaires with large numbers of respondents to test hypotheses;

Operational Research Methods (Meredith, Raturi, Amoako-Gyampah, Kaplan, 1989): quantitative modelling of loads and flows of service operations;

Experimental method (Campbell & Stanley, 1979): verification of causality relations, with focus group and control group;

Research-action (Stringer, 2007, Thiollent, 2003, Vergara, 2004): intervention in organizations for diagnosis and problem solving;

Qualitative methods in general (Denzlin & Lincoln, 1994, Cardoso, 1986): relevant for research in Services, taking care of methodological rigor;

Case studies (Yin, 2015, Dubé & Paré, 2003, Stake, 2005): questions "how and why" in phenomena of the present time in real contexts;

Technical interview (Bryman & Cassel, 2006, Rapley, 2004, Spradley, 1979): gets the perception, opinion and inferences of the subjects about the topic in focus;

Focus Group Technique (Macnaghten & Myers, 2004): gets the perceptions and the debate of opinions of several subjects (stakeholders);

Documentary research technique (Prior, 2004): gets records of events, structures, situations (mailing, records of meetings);

Participant observation technique (Serva & Jaime, 1995, Tedlock, 2003): gets perceptions of behaviors and ratios in the context of real events;

Data analysis (specifically Content Analysis) (Bardin, 2004): validation of inferences for a context, according to components and relations.

Researchers on methodology have already reflect about the evident associations between Literature and Research Methodology: "Research is always a new adventure on which to reflect" (Cardoso, 1986), and "Every literary work is essentially a research" (Beauvoir as cited in Fischer, Davel, Vergara, Ghadiri, 2006). The approximations between Literature and Research Methodology briefly described below are based on the work of Pinheiro and Vieira (2008). The authors argue that, as in literary writing, the writing of scientific articles is guided by an effective convincing strategy to engage and persuade readers, in this case, about the nexus between theory and results being demonstrated and defended in the work (Pinheiro

& Vieira, 2008). The narrative-descriptive strategy, used in Literature and Research (in the writing of scientific articles), usually includes the detailed description of time and space, environment and scenarios (organization, structures, customs), description and psychological profile of the characters (clients, suppliers, employees), and the web of relationships that connects everyone, with the plot, or the events that make up the administrative routines or service processes, transporting the reader into the "soul" of the subject of study.

A plethora of literary texts can be appreciated as effective descriptive-explanatory case studies on past and present facts. Most narratives respond to the classic questions "how?" and "why?" asked in the case studies (Yin, 2015), and do so from multiple sources of data such as descriptions of the environment, character testimonials, and narratives of events occurred, also similarly to the case study as a methodological procedure (Pinheiro & Vieira, 2008).

Different teaching experiences in the area with the use of literary works as material of support and complement are reported by Pinheiro and Vieira (2008). An example is the use of Eugen Herrigel's "A Arte Cavalheiresca do Arqueiro Zen", for Research Methods. Another example is the use of the text "Terra Molhada de Siena", from José Saramago's "A Bagagem do Viajante", in Research Methods for MBA classes reported by Baêta (2007). It is worthy to highlight the analogy between several pieces of this book and the stages of a scientific research project, which allows the reading and discussion of the text to cover the formulation of the research question, the design of a research strategy, and the analysis of results.

Fischer et al. (2006) approach the research in organizations and the use of literary texts in the production of knowledge. They affirm that Literature has adepts among researchers as a research resource (writing in the form of narrative, and the literary narratives that can serve the research). They also emphasize that Literature has been used with growing enthusiasm in the teaching of Production Engineering, but it is an unexplored field in Brazil. In this sense, some reflections on the parallels between Literature and scientific methods are used for the generation or verification of knowledge in the most diverse fields (Pinheiro & Vieira, 2008).

Alves (2007) also argues that the relationships established between art and methodology of research, literature, narrative, aesthetic creation and literary writing can add significant novelties to the teaching, research and professional training process. This is what we aim to accomplish in this research.

The character Sherlock Holmes is an Advisory Detective who lives in London at 221B Baker Street in the Victorian era with his friend Dr. John Watson. He is a famous investigator for his use of scientific method and deductive logic for solving mysteries, with impressive deduction ability and sense of observation, and a wide general culture. He assisted the Metropolitan Police of London (Scotland Yard) whenever he was consulted, sometimes using unorthodox methods (Best of Sherlock Holmes, 2010). Sherlock Holmes "has joined that select of literary characters whose fame has soared beyond literature – along with Hamlet, Don Quixote, Samuel Pickwick, Svengali, and Harry Potter" (Sutherland, 2014). He is the

character of the world-wide literature that received the greatest number of adaptations (theatre, cinema, comics, games), studies and speculations, including The Sherlock Holmes Society of London, a club that is dedicated to study it and maintains its museum, located at 221B Baker Street, "the most famous address in the world" (Sherlock Holmes Museum, 2018).

Sir Arthur Conan Doyle is among England's first writers of short stories and novels about detective. When he began to write them, there was a great demand for stories, as more people were being educated and literate, and thus met the demand for fantastic texts of a nascent mass culture (Sherlock Holmes Museum, 2018). He devised a "science detective" in creating the Sherlock Holmes character, and with it, consolidated a model of the literary novels, according to a current optimism (on science and its discoveries) common in his time, the time of Huxley, Tyndall, Darwin, Spencer and Stuart Mill in England. In this sense, the character conveyed the author's ideas, impregnated with scientific values, among them Positivism, dominant in society when the stories were created (Silva, 2010).

Method

This research is characterized as qualitative, exploratory and descriptive. The method of investigation applied consists of a bibliographical survey. The research theme is the Research Methodology identified in the Sherlock Holmes investigations. The context of this research lays on science teaching and the reaching of innovations that can get the attention of the students.

Object of Study: The research corpus (the sources to be analyzed) was specifically delimited to the so-called Sherlockian Canon: "the set of all the works of Sherlock Holmes published by Sir Arthur Conan Doyle; that is, the four novels and the 56 short stories" (Sherlock Holmes Museum, 2018) (see APPENDIX 1). The choice of corpus is justified because: "Everything we know about the detective's life comes exclusively from the canon, and this is therefore the most faithful source of study on the Great Detective's universe" (Sherlock Holmes Museum, 2018). The books of the canon are traditionally identified with acronyms as follows:

Novels

[STU] A Study in Scarlet (1887)

[SIG] The Sign of Four (1890)

[HOU] The Hound of the Baskervilles (1902)

[VAL] The Valley of Fear (1915)

Books of short stories

(See APPENDIX 1 for acronyms for the 56 short stories)

[ADV] Adventures of Sherlock Holmes (1892)

[MEM] The Memoirs of Sherlock Holmes (1893)

[RET] The Return of Sherlock Holmes (1905)

[BOW] His Last Bow (1917)

[CAS] The Case-Book of Sherlock Holmes (1927)

Data Collection Procedures: Data collection included obtaining all texts (in Portuguese) in physical books (the L&PM publisher's pocket collection was chosen), and the download of all the texts of the canon from the Camden House website (2014) and from the Sherlock Holmes Museum website (2018), to a personal computer, thus forming a database, available on request. All the narratives (both novels and short stories) were read, first in English and then in Portuguese, followed by the detachment of all the excerpts (of the English version) with the potential to reveal recommendations of investigation methods by the Great Detective. For purposes of research replicability, it is worth noting that all the works that make up the canon can be found in Portuguese (editors: Ediouro, Melhoramentos, L&PM), and in English, in those mentioned websites.

Data Analysis Procedures: Data analysis consisted of the comparison of selected excerpts as an illustration of research methods and recommendations to guarantee the methodological rigor that are traditionally indicated by scientific articles and recognized textbooks of the Research Methods area in Production Engineering. The search for evidences followed this process, in which interpretation is a worthy tool borrowed from the science field of Literature.

Results and discussion

This section presents the results of the research, commented, for discussion and analysis face to the theoretical reference of the research methods presented in section 2. It consists in more than just trying to manage to find any correlation between various citations of the books, and shows the results of an interpreting and comparing process, useful and repeatable, even in classes of science teaching. Quotations from excerpts use the canonical acronyms of the stories as reference (see APPENDIX 1).

In several stories, there are identified passages in which the character defines himself and his methods of investigation. Some of its "maxims" clearly sound like recommendations of methodological rigor for the research in Production Engineering.

My name is Sherlock Holmes. It is my business to know what other people don't know. [BLUE] [ADV]

I have a turn both for observation and for deduction. [STU]

I am an omnivorous reader with a strangely retentive memory for trifles. [LION] [CAS]

Perhaps I have trained myself to see what others overlook. [IDEN] [ADV]

The world is full of obvious things which nobody by any chance ever observes. [HOU]

You know my method. It is founded upon the observation of trifles. [BOSC] [ADV]

It has long been an axiom of mine that the little things are infinitely the most important. [IDEN] [ADV]

> Never trust to general impressions, my boy, but concentrate yourself upon details. [IDEN] [ADV]

One of the most frequent recommendations of Sherlock Holmes refers to the importance of details. The same recommendation can be deduced from the reading of works on Case Study (Yin, 2015, Dubé & Paré, 2003) and Participating Observation (Tedlock, 2003). Observation in research allows the observer to construct a lifeworld image of those being observed and an understanding of how they commonly act in relation to their daily activities (Stringer, 2007). And they also should record their observations as field notes, noting especially important details for formulating descriptions: places, persons, objects, acts, activities, events, purposes, time, sensations (Stringer, 2007). As in Holmes adventures, field notes are the most common feature used for observations. And nowadays videotapes and photographs can also offer powerful records of events and activities (Bauer & Gaskell, 2002).

> There is nothing like first-hand evidence [STU]

Among the "first-hand evidence" valued by Sherlock Holmes is data from interviews with participants in the context of the research, as authors of method texts emphasize. For example: appropriate questions allow researchers to describe the situation on the terms of the participants themselves, when they create opportunities to engage in interviews and conversations that extend the range of information available (Spradley, 1979). It is worthy record that typically, multiple methods are employed, and ideally, two or more sources should be used, for the aim is to obtain rich data on the specific research question, as well as capture the contextual complexity (Benbasat, Goldstein, Mead, 1987). One characteristic of Sherlock Holmes, important to his success, was that he was an eminently urban type and knew how to take advantage of all that life in the city could offer and was part of the life of his readers (Silva, 2010). In his adventures he makes abundant use of the conditions brought by modernity: trains, rental cars, the telegraph and the various newspapers as sources of information.

> All knowledge comes useful to the detective. [VAL]

> It is a hobby of mine to have an exact knowledge of London. [REDH] [ADV]

> Any truth is better than indefinite doubt. [YELL] [MEM]

> […] a man should keep his little brain-attic stocked with all the furniture that he is likely to use, and the rest he can put away in the lumber-room of his library, where he can get it if he wants it. [FIVE] [ADV]

The importance of the prior knowledge of the researcher's specialist on the themes of the case study is emphasized in the recommendation that they must be used (Yin, 2015). In case studies, results depend on the integrative power of the researchers (Benbasat, Goldstein, Mead, 1987). And multiple methods allow triangulation, so a clear chain of evidence (objectives - questions - assertions - design choices - uncovered data – results – conclusions) should be built.

However, an important distinction can be drawn from the following excerpts:

> We approached the case, you remember, with an absolutely blank mind, which is always an advantage. We had formed no theories. We were simply there to observe and to draw inferences from our observations. [CARD] [BOW]

> It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts. [SCAN] [ADV]

> I never guess. It is a shocking habit – destructive to the logical faculty. […] I never make exceptions. An exception disproves the rule. [SIG]

> It is a capital mistake to theorize in advance of the facts. [SECO] [RET]

> It is a capital mistake to theorize before you have all the evidence. It biases the judgment. [STU]

It is one of the most reinforced "maxims" of Sherlock Holmes: not theorizing before having all the data. The recommendation applies to both the quantitative methods (survey research – for example: Freitas et al., 2000) and qualitative methods, such as the Case Study, for example, which is suitable for capturing the knowledge of practitioners and develop theory from it, and requires little prior specification of dependent variables and their measurements allow the use of a high degree of discretion in structuring and interpreting data (Benbasat, Goldstein, Mead, 1987).

> It is of the highest importance in the art of detection to be able to recognize, out of a number of facts, which are incidental and which are vital. Otherwise your energy and attention must be dissipated instead of being concentrated. [REIG] [MEM]

This distinction between what is fundamental among all the collected data converges with Yin's (2015) recommendation of the Desirable Skills for the Researcher which includes being able to ask good questions, interpret the answers, be a good listener, adaptable and flexible, have clear notion of the issues being studied and be unbiased about preconceived notions. This latter ability may also be referenced to Sherlock Holmes's previously quoted maxim of not theorizing without having the data.

> […] one true inference invariably suggests others. [SILV] [MEM]

> From a drop of water, […] a logician could infer the possibility of an Atlantic or a Niagara without having seen or heard of one or the other. So all life is a great chain, the nature of which is known whenever we are shown a single link of it. [STU]

> The observer who has thoroughly understood one link in a series of incidents should be able to accurately state all the other ones, both before and after. [FIVE] [ADV]

In these passages, Holmes highlights the process of linking inferences from the evidence. In this sense, the recommendations for Research Reports (Yin, 2015, Dubé & Paré, 2003) say that it is essential to maintain a

chain of evidence, which should be clear, in a way which the reader could be able to follow the derivation of any evidence, from research questions to conclusions, as Watson does in his writings.

The detective method used by Conan Doyle for a scientific detection is explained according to the categories of Philosophy and within the prescriptions of Classical Logic. The English philosopher Peirce (1839-1914) considers that, besides deduction and induction, there is abduction, which is a kind of intuition that does not happen at once, but goes step by step to reach a conclusion. Abduction is the search for a conclusion by the rational interpretation of signs, signals and indications. It is the form that reason possesses when it begins the study of a new scientific field that had not yet been approached, as in the case of Service Science. The simplest example offered by Peirce to explain what abduction is the police tales, the way detectives are collecting clues or signs, and forming a theory for the case they investigate (Chauí, 2004).

> In solving a problem of this sort, the grand thing is to be able to reason backward. That is a very useful accomplishment, and a very easy one, but people do not practice it much. In the everyday affairs of life it is more useful to reason forward, and so the other comes to be neglected. [STU]

The method of producing knowledge presented in their histories can be considered a model of reasoning by which the possibilities are perceived by orienting the intellectual vectors in the direction of the effects to the causes, as if they were retrospective prophecies, and their histories symbolize adductive knowledge, which opposes purely deductive rationalism since the seventeenth century (Silva, 2010). The adventures of Sherlock Holmes are presented as a model of scientific procedure and a mirror of nineteenth-century science in them (Silva, 2010). In this historical sense, it can be said that Holmes's philosophical conceptions and methods can be classified, as far as the paradigmatic and epistemological position, as positivist or post-positivist. The paradigm positivist takes a position of realism and relies on the assumption of an objective world external to the mind, and the post-positivism states that reality can only be known probabilistically (Gephart, 2004). Another essential characteristic of these two paradigms is a seeking to discover "the" truth or "true" reality. This aspect becomes clear in Holmes' "maxim" more emphasized in the canon:

> It is an old maxim of mine that when you have excluded the impossible, whatever remains, however improbable, must be the truth. [BERY] [ADV]

> How often have I said to you that when you have eliminated the impossible, whatever remains, however improbable, must be the truth? [SIG]

> […] when you have eliminated all which is impossible, then whatever remains, however improbable, must be the truth. [BLAN] [CAS]

> We must fall back upon the old axiom that when all other contingencies fail, whatever remains, however improbable, must be the truth. [BRUC] [BOW]

> That is the case as it appears [to the police], and improbable as it is, all other explanations are more improbable still. [SILV] [MEM]

> […] we balance probabilities and choose the most likely. It is the scientific use of the imagination. [HOU]

Yin (2015) also emphasizes that the research report should show that it relied on all the evidence, should cover all the main competing interpretations, and should focus on the most significant aspects of the case. The same way as logical deductions can be obtained through verbal propositions, the researcher establishes relationships between conceptual models and real empirical behavior, and these deductions must be tested (Pozzebon & Freitas, 1997). Thus, the possible competing explanatory theories must therefore be formulated and considered, without fear, to be then subjected to validity tests, eliminating all those that reveal failures (impossibilities) in the confrontation with the data. This kind of process enables researchers to verify the veracity of observations, and this way must be checked for efficacy any deductions concerning feelings and purposes that can be inferred only superficially by an observer (Spradley, 1979).

> One should always look for a possible alternative, and provide against it. It is the first rule of criminal investigation. [BLAC] [RET]

> Watson, you can see everything. You fail, however, to reason from what you see. You are too timid in drawing your inferences. [BLUE] [ADV]

> […] when a fact appears to be opposed to a long train of deductions, it invariably proves to be capable of bearing some other interpretation. [STU]

> Circumstantial evidence is a very tricky thing. […] It may seem to point very straight to one thing, but if you shift your own point of view a little, you may find it pointing in an equally uncompromising manner to something entirely different. [BOSC] [ADV]

In any type of research, attention must be focused to facts that cannot be explained by theory. For example, in survey research, the presence of outliers (Hair et al., 2005) always requires explanation. Likewise, in qualitative research, non-standard occurrences and behaviors should be reviewed (Dubé & Paré, 2003). In this way, the researcher's flexibility is of greater importance, because, at any moment during the investigation, the researcher develops new hypotheses, and then some changes of unit of analysis and method of data collection can be made (Benbasat, Goldstein, Mead, 1987). Or, in other words, it is to elaborate other possible new explanatory theories, in the face of the perception that current working hypotheses do not satisfactorily explain the facts.

To close this series of recommendations of the Great Detective, the most worth "maxims" that he adopts when referring to the profession of investigator seem to be the followers. These excerpts can represent "tips" for the researchers.

> Education never ends, Watson. It is a series of lessons with the greatest for the last. [REDC] [BOW]

> Breadth of view […] is one of the essentials of our profession. The interplay of ideas and the oblique uses of knowledge are often of extraordinary interest. [VAL]

> […] the Science of Deduction and Analysis is one which can only be acquired by long and patient study, nor is life long enough to allow any mortal to attain the highest possible perfection in it. [STU]

The "broad view" to which Holmes refers, essential to the researchers, can be associated with the perception of the mentioned potential contribution of the possible relationships of Production Engineering to the Arts, especially on Research Methods, overcoming stereotypes and exploring multidisciplinarity. The links identified in the sections cited here are useful for understanding different aspects of research methods, which may contribute to develop the teaching-learning process of this topic.

Conclusions

This research has achieved its goal of identifying "clues" to recommendations of useful research methods for Production Engineering reported as research methods used by the Sherlock Holmes character. The results of this work reinforce some findings of Silva (2010), which deduces a list of recommended skills for a detective (or, in this case, for Production Engineering researchers): observation and deduction skills; retrospective or analytical reasoning; specific knowledge about the subject matter involved in the case under study; imagination for alternative research strategy; patience and the prudence of never theorizing without having all the possible indications; always separate the essential from the accidental; eliminate all that is impossible; and create hypotheses that must be proven.

Among the methods used by Sherlock Holmes that are also useful for research in Production Engineering, we highlight the Case Study, with its Observation and Interviews techniques. One could say that Watson's accounts of the adventures of his friend Sherlock Holmes resemble case study reports from multiple sources of data such as descriptions of the environment, character accounts, and fact narratives occurred. Moreover, great importance stands out in the detective's recommendations regarding data analysis and the elaboration of explanatory theories. The logical and methodological rigor recommended for the validity of the inferences obtained from the data echoes the "maxims" of the Great Detective in all aspects of an investigation.

Among these maxims emphasized by the character throughout the stories of the canon, the most repeated is that about eliminating the impossible, what remains, even if unlikely, must be the truth – which strong links to Positivism. Other recommendations of methodological rigor, essential for the art of investigation in several areas of knowledge, can also be highlighted: observing the details and trivial things, not forming theories before the facts and indications in order not to distort the reasoning nor to twist the facts to accommodate them to the theories, showing a whole chain of inferences from the evidence to the theory that explains them all.

This conclusion reinforces the idea that the methodological rigor applied in the use of data collection and analysis techniques, as well as the correct

proposition of research questions and problems, are essential issues in the area of Research Methodology. Similar future research could investigate the methods of other famous literary detectives, such as Miss Marple, or Hercule Poirot of Agatha Christie, or Auguste Dupin of Edgar Allan Poe.

The research results are materialized in illustrative excerpts of methods used by Sherlock Holmes, and the data analysis compares them with consolidated methods of Research in Production Engineering. It is understood that the work is rich, interesting and relevant to the area, as it provides a complementary spectrum and helps the teaching-learning process of Research Methods in Production Engineering.

This paper tries to present a new look or a new approach on research methods, capable of raising and motivating interesting discussions in the research community in Production Engineering, particularly with the unusual contribution that an area such as Literature can offer for this science. Thus, hoping that the presented panorama offers ample potential to complement the teaching-learning process, for the sake of the rigor in application of research methods in Production Engineering, it is worth remembering, according to Sherlock Holmes, that the intertwining of ideas always offers an extraordinary interest.

References

Alves, L. (2007, September). Por um saber administrativo que compartilhe a história da cultura brasileira. *Anais do Encontro Nacional da Associação Nacional de Pós-Graduação e Pesquisa em Administração*, Rio de Janeiro, RJ, Brasil, 31.

Abepro – Associação Brasileira de Engenharia de Produção. (2019). *Encontro Nacional de Engenharia de Produção: Áreas e Subáreas*. Retrieved August 24, 2019, from http://portal.abepro.org.br/enegep/regras-para-submissao/

Baêta, A. (2007). Saramago no ensino e aprendizagem de metodologia de pesquisa. Em E. Davel, S. Vergara, & D. Ghadiri (Org.). *Administração com arte*. São Paulo: Atlas.

Bardin, L. (2004). *Análise de conteúdo*. (3a ed.). Rio Janeiro: Edições 70.

Bauer, M.W., & Gaskell, G. (2002). *Pesquisa Qualitativa com Texto, Imagem e Som.* Petrópolis, RJ: Vozes.

Benbasat, I., Goldstein, D., & Mead, M. (1987). The case research strategy in studies of information systems, *MIS Quarterly*, 11(3), 369-387.

Best of Sherlock. (2010). *The best of Sherlock Holmes: Beeton's Christmas Annual 1887*. Recuperado de http://www.bestofsherlock.com/index.htm

Bryman, A., & Cassel, C. (2006). The researcher interview: a reflexive perspective. *Qualitative research in organizations and management*, 1(1), 41-55.

Camden House. (2014). *The complete Sherlock Holmes*. Recuperado de http://ignisart.com/camdenhouse/canon/index.html

Campbell, D.T., & Stanley, J.C. (1979). *Delineamentos experimentais e quase-experimentais de pesquisa*. São Paulo: EDUSP.

Cardoso, R. (1986). Aventuras de antropólogos em campo ou como escapar das armadilhas do método. In R. Cardoso (Org.). *A aventura antropológica: teoria e pesquisa*. Rio de Janeiro: Paz e Terra.

Chauí, M. (2004). *Convite à Filosofia*. (13a ed.). São Paulo: Ática.

Denzlin, N.K., & Lincoln, Y.S. (Eds.) (1994). *Handbook of qualitative research*. Newbury Park: Sage.

Dubé, L., & Paré, G. (2003). Rigor in IS positivist case research. *MIS Quarterly*, 27(4), 597-635.

Fischer, T., Davel, E., Vergara, S.C., & Ghadiri, S.D. (2006, September). Razão e sensibilidade no ensino de administração: a literatura como recurso estético. *Anais do Encontro Nacional da Associação Nacional de Pós-Graduação e Pesquisa em Administração*, Salvador, BA, Brasil, 30.

Freitas, H., Oliveira, M., Saccol, A.Z., & Moscarola, J. (2000). O método de pesquisa survey. *Revista de Administração*, 35(3), 105-112.

Gephart, R.P., Jr. (2004). Qualitative research and the Academy of Management Journal. From the Editors. *Academy of Management Journal*, 47(4), 454-462.

Hair, J.F., Babin, B., Money, A.H., & Samouel, P. (2005). *Métodos de pesquisa em administração*. Porto Alegre: Bookman.

Malanovicz, A.V. (2016, September). Lições de negócios de Game of Thrones e As Crônicas de Gelo e Fogo. *Anais do Encontro Nacional da Associação Nacional de Pós-Graduação e Pesquisa em Administração*, Costa do Sauípe, BA, Brasil, 40.

Malhotra, N.K. (2006). *Pesquisa de marketing*. Porto Alegre: Bookman.

MacNaghten, P., & Myers, G. (2004). Focus group. In C. Seale (Ed.). *Qualitative research practice*. London: Sage, pp.65-79.

Meredith, J.R., Raturi, A., Amoako-Gyampah, K., & Kaplan, B. (1989). Alternative research paradigms in operations. Journal of Operations Management, 8(4), 297-326.

Pinheiro, I.A. & Vieira, L.J.M. (2008). Construindo as pontes entre saberes: da Literatura à Gestão. *Congresso Virtual Brasileiro*. Recuperado de www.convibra.com.br/2008/artigos/214_0.pdf

Pozzebon, M., & Freitas, H. (1997, September). Pela aplicabilidade – com um maior rigor científico – dos estudos de caso em sistemas de informação. *Anais do Encontro Nacional da Associação Nacional de Pós-Graduação e Pesquisa em Administração*, Angra dos Reis, RJ, Brasil, 21.

Prior, L. (2004). Documents. In C. Seale (Ed.). *Qualitative research practice*. London: Sage.

Rapley, R. (2004). Interviews. In C. Seale (Ed.). *Qualitative research practice*. London: Sage.

Serva, M., & Jaime, P., Jr (1995). Observação participante e pesquisa em administração: uma postura antropológica. *Revista de Administração de Empresas*, 35(1), 64-79.

Sherlock Holmes Museum (2018). *The Sherlock Holmes Museum*. Recuperado de http://www.sherlock-holmes.co.uk/home.htm

Silva, D.F. (2010). A ciência em Sherlock Holmes. *Revista Tessituras*, n.1, Nova Friburgo. Recuperado de http://www.docentesfsd.com.br/

Spradley, J.P. (1979). *The ethnographic interview*. New York: Holt, Rinehart & Winston.

Stake, R.E. (2005). Qualitative case studies. In N.K. Denzin & Y.S. Lincoln (Eds.). *The Sage handbook of qualitative research*. (3rd ed.). London: Sage. pp. 443-466.

Stringer, E. (2007). *Action research: handbook for practitioners*. Thousand Oaks: Sage.

Sutherland, J. (2014, March). *Sherlock Holmes, the world's most famous literary detective*. British library: Discovering literature: romantics & Victorians. Recuperado de https://www.bl.uk/romantics-and-victorians/articles/arthur-conan-doyle-the-creator-of-sherlock-holmes-the-worlds-most-famous-literary-detective

Sutton, R.I., & Staw, B.M. (2003). O que não é teoria, *Revista de Administração de Empresas*, 43(3), 65-84.

Tedlock, B. (2003). Ethnography and ethnographic representation. In N.K. Denzin, & Y.S. Lincoln (Eds.). *Strategies of qualitative research*. London: Sage, pp.165-213.

Thiollent, M. (2003). *Pesquisa-ação nas organizações*. São Paulo: Cortez.

Vergara, S.C. (2004). *Projetos e relatórios de pesquisa em Administração*. São Paulo: Atlas.

Yin, R.K. (2015). *Estudo de caso: planejamento e métodos*. Porto Alegre: Bookman.

Appendix 1 – Research corpus: The Sherlockian canon

Novels
[STU] A Study in Scarlet (1887)
[SIG] The Sign of Four (1890)
[HOU] The Hound of the Baskervilles (1902)
[VAL] The Valley of Fear (1915)

Short Stories Books
[ADV] Adventures of Sherlock Holmes (1892)
[SCAN] A Scandal in Bohemia
[REDH] The Red-headed League
[IDEN] A Case of Identity
[BOSC] The Boscombe Valley Mystery
[FIVE] The Five Orange Pips
[TWIS] The Man with the Twisted Lip
[BLUE] The Adventure of the Blue Carbuncle
[SPEC] The Adventure of the Speckled Band
[ENGR] The Adventure of the Engineer's Thumb
[NOBL] The Adventure of the Noble Bachelor
[BERY] The Adventure of the Beryl Coronet
[COPP] The Adventure of the Copper Beeches

[MEM] The Memoirs of Sherlock Holmes (1893)
[SILV] Silver Blaze
[YELL] The Yellow Face
[STOC] The Stock-broker's Clerk
[GLOR] The "Gloria Scott"
[MUSG] The Musgrave Ritual
[REIG] The Reigate Puzzle
[CROO] The Crooked Man
[RESI] The Resident Patient
[GREE] The Greek Interpreter
[NAVA] The Naval Treaty
[FINA] The Final Problem

[RET] The Return of Sherlock Holmes (1905)
[EMPT] The Adventure of the Empty House
[NORW] The Adventure of the Norwood Builder
[DANC] The Adventure of the Dancing Men
[SOLI] The Adventure of the Solitary Cyclist
[PRIO] The Adventure of the Priory School
[BLAC] The Adventure of Black Peter
[CHAS] The Adventure of Charles Augustus Milverton
[SIXN] The Adventure of the Six Napoleons
[3STU] The Adventure of the Three Students
[GOLD] The Adventure of the Golden Pince-Nez
[MISS] The Adventure of the Missing Three-Quarter
[ABBE] The Adventure of the Abbey Grange
[SECO] The Adventure of the Second Stain
[BOW] His Last Bow (1917)
[WIST] The Adventure of Wisteria Lodge
[CARD] The Adventure of the Cardboard Box
[REDC] The Adventure of the Red Circle
[BRUC] The Adventure Bruce-Partington Plans
[DYIN] The Adventure of the Dying Detective
[LADY] The Disappearance of Lady Frances Carfax
[DEVI] The Adventure of the Devil's Foot
[LAST] His Last Bow
[CAS] The Case-Book of Sherlock Holmes (1927)
[ILLU] The Adventure of the Illustrious Client
[BLAN] The Adventure of the Blanched Soldier
[MAZA] The Adventure of the Mazarin Stone
[3GAB] The Adventure of the Three Gables
[SUSS] The Adventure of the Sussex Vampire
[3GAR] The Adventure of the Three Garridebs
[THOR] The Problem of Thor Bridge
[CREE] The Adventure of the Creeping Man
[LION] The Adventure of the Lion's Mane
[VEIL] The Adventure of the Veiled Lodger
[SHOS] The Adventure of Shoscombe Old Place
[RETI] The Adventure of the Retired Colourman