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The relationship between personality and decision-making: A Systematic literature review

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ABSTRACT

Context: From a point of view, software development is a set of decisions that need to be made while the software is developed. Many alternatives should be considered, such as the technology to employ, or the most important features to implement. However, many factors can influence one's decision-making, such as the decision maker's personality.

Objective: This paper reports the state of the art with regard to the relationship between decision-makers' personality and decision-making aspects.

Method: We conducted a Systematic Literature Review to search and analyze published primary studies that discuss the abovementioned relationship in the context of companies that develop any kind of product or service.

Results: Despite the recognized influence of personality in decision-making activities, we were not able to find any study in Software Engineering field that discusses this relationship. We included 15 studies and most of them are from Management field, excluding one from Information System field. From these studies, we identified 75 reported relationships between 28 different personality aspects and 30 different decision-making aspects.

Conclusion: The interest in this topic born on 80's and it has grown after 2002. However, despite the number of reported relationships, and the number of personalities and decision-making aspects investigated, more research on this topic is necessary. In particular, it is important to verify how someone's personality influences the decision-making considering the software development context. This can help in improving how a decision is made in software engineering context.

1. Introduction

Software Engineering (SE) shares with the other Engineering fields the same principles to "create cost-effective solutions to practical problems, by applying the scientific knowledge" (when available), "to building things in the service of mankind" [1].

However, unlike in other Engineering fields, "software is symbolic, abstract, and more constrained by intellectual complexity than by fundamental physical laws". Software is also "design-intensive". In other Engineering fields, all more mature than SE, there has been an organization of a body of design decision knowledge that can be used to provide guidance to help people make decisions about what they are going to do. SE is not there yet - there is a lack of mature systematically organized knowledge & science shaping design decisions, and also lack of proper reference materials that make explicit existing knowledge and experience [1,2]. An exception to the rule may be in software architecture; however, a lot more is needed in order to help software-related decision making. The recent examples of data breaches, cyber attacks, and so on clearly expose vulnerabilities in software-related decisions [1,2]. Therefore, given such differences, it is very important to understand the decision-making phenomena within the specific context of Software Engineering.

A decision is the result of a decision-making process, which investigates and compares alternatives, looking for the best one according to the assessment criteria being used [3]. Such a process is also used extensively in the context of software development, which can be conceived as a set of decisions [4]. During a software development project, for example, many decisions need to be made: to decide between developing or buying a software; to decide what technology should be employed during the software development; to

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decide how to deliver the software to the customer, among other decisions [4].

Decisions can be influenced in numerous ways. A literature review conducted by Jia et al. [5] aimed to identify which environmental factors impacted on individual decision-making, considering the Software Engineering (SE) context. They identified 40 papers from where they extracted 237 factors and classified them into eight categories: task characteristics, power, balance between work & life, career, managerial characteristics, organization characteristics, and team characteristics.

However, there are other factors, other than environmental, which can influence decision-making. Since decisions are made by people, there are also many human factors that can likely influence decision-making, such as, for example, the decision-makers' experience, the communication between decision-makers, the level of stress on the decision-makers, and decision-makers' cognitive style. The study reported in [6] discusses influences of emotion on decision-making and the study in [7] identified eight influential factors upon software project management decisions, which include cognitive bias. Finally, another important aspect that influences decision making is the decision maker's personality [8].

Personality is a set of important and stable characteristics of behavior [9, chap. 1]. There are many perspectives to study human personality: biological, cognitive, humanistic, learning, psychodynamic and trait [10, chap. 1]. Among all these perspectives there is the trait perspective that focuses on individual differences and comprehensive traits models to help on behavioral prediction. There are many models that classify the variation of personality in the population, for example, Five-Factor Model, Three Factors Model, among others [11, chap. 8].

Despite the clear relevance that decision-makers' personalities have upon the decisions they make and in the process employed, we were unable to identify any software engineering study that investigated such relationship, as will be detailed in Section 2. The goal and main contribution of this paper is to report a Systematic Literature Review (SLR) on the relationship between decision-making and decision-maker's personality, considering the context of companies that develop any kind of product and service, involving different decision levels (for example, strategic, project, and technology). Therefore, this SLR will help on understanding how people's personality can impact on decision-making process and outputs.

The remainder of this paper is structured as follows: Section 2 presents related works to this literature review, followed by Section 3 that describes the research method adopted to execute this literature review. Section 4 summarize the results and Section 5 discusses the results. Finallu, Section 6 provides our conclusions and comments on future works.

2. Related work

Within the context of SE, we identified one SLR that discusses decision-making and one Mapping Study (MS) that discusses personality, all of which are presented next. The SLR conducted by [12] aimed to analyze papers related to decision-making in software project management; they included 27 papers in their review. The primary research question they addressed was "how do software project managers make decisions?" The authors classified those articles into eight categories: 1) nine papers in agile development practices; 2) four papers in participatory decision-making, 3) four papers in escalation and de-escalation commitment factors, 4) three papers in stakeholders' involvement; 5) two papers in cognitive bias; 6) two papers in using rational methods; 7) one paper in emotion; and 8) one paper in communication. The aim of the [12]'s SLR is to draw a picture of the research on decision making in SE, however, they do not discuss the relationship between personality and decision-making. Despite this, among the papers included by [12], we found one that explores the relationship between decision-making and emotion [6]). Emotion can be studied as a personality trait; however, the included paper did not study emotion as a personality aspect.

The MS presented by [13] covered 40 years of research on personality in SE. The main research question that the authors investigate was: "What is the current state of academic research on personality in software engineering?". They identified 90 studies that investigated personality in SE field. The research topics with the higher number of articles are pair programming in 20% of the papers; education in 17% of the papers, and team performance in another 13%.

Before starting this SLR, we analyzed the title and abstract of all 90 papers included in [13] in order to look for studies that would comply with our inclusion criteria. We were not able to find any paper that investigates the relationship between personality and decision-making among the included articles, nor any SLR in SE that investigates such relationship.

Another study related to decision-making was conducted by da Cunha et al. [7] and it aimed to identify the perception of decision-makers in software project management. The authors conducted semi-structured interviews and analyzed the data using some techniques from Grounded Theory. They identified three sets of factors related to decision-making in software engineering: decision features, situational factors, and individual differences. Personality was identified as an individual factor in software project decision-making. However, the contribution of the paper about the relationship between personality and decision making is just a statement that personality is a factor in decision-making.

Since we were not able to find any study in the Software Engineering field that truly discusses the relationship between personality and decision-making, we decided to expand the scope of our search for other domains.

Within the management domain, we identified one literature review that explores the influence of personality on decision making of top management teams [8]. They identified 29 studies and classified the results considering a widely-used personality framework: Five-Factor Model. Considering this model, most of the papers concentrated on emotional stability factor (41%), followed by extroversion and conscientiousness (30% each), openness to experience (15%), and agreeableness (11%). Note that the sum of the percentages is greater than 100% because one paper can discuss more than one personality factor simultaneously. Despite the SLR [8] investigated the relationship we were interested in; it did not focus upon Software Engineering.

In summary, as there was no other SLR or study found that investigated the relationship between decision makers' personalities and the decision-making, within the context of Software Engineering, we decided to conduct an SLR which aimed to provide evidence about studies that **explore the relationship between personality and decision-making considering the context of companies that develop any kind of product or service**. Furthermore, our SLR also explores other fields in addition to SE.

3. Research method

The SLR reported herein was carried out from April to November 2017. Fig. 1 illustrates the SLR process which was based on the process proposed by [14]. The three phases illustrated in Fig. 1 are planning, executing and reporting.

The Planning Phase established the need for a literature review, identified the SLR goals, the scope, research questions, search strategy, selection criteria, and extraction. In the Executing Phase, all the processes defined in the earlier phase were executed and recorded. The Reporting Phase was related to reporting and evaluating the SLR process.

The second and third authors are experienced researchers who have already conducted, and participated in at least 20 and 4 SLRs, for the past 14 and 12 years, respectively. Their role was to validate the papers' selection, the data extraction, and the results. Further details of such validation are shown in Fig. 2.

The validation had three points: selection, data extraction, and results. The validation of papers' selection was completed when we

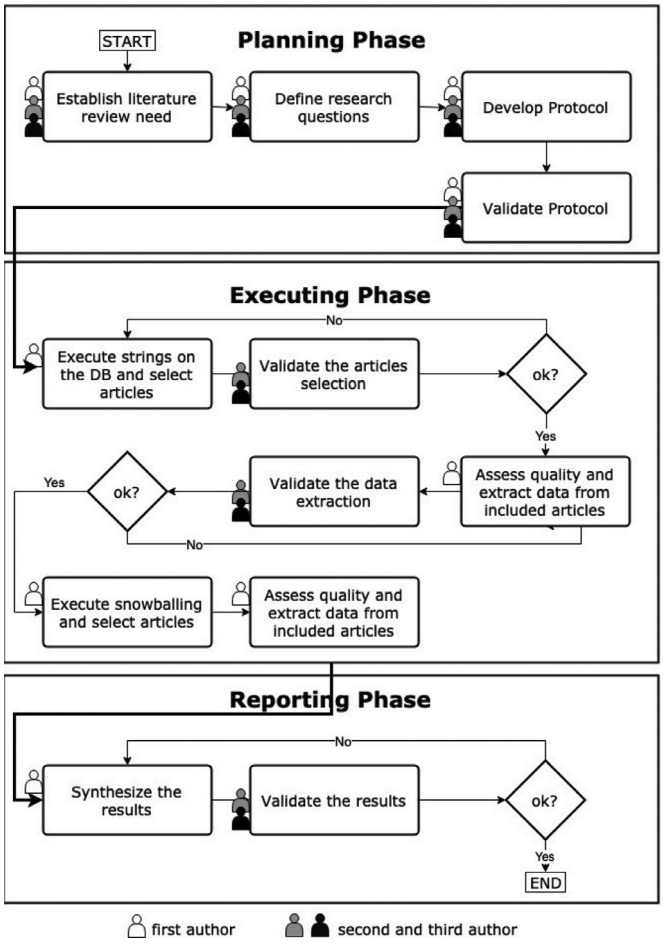

Fig. 1. SLR Process.

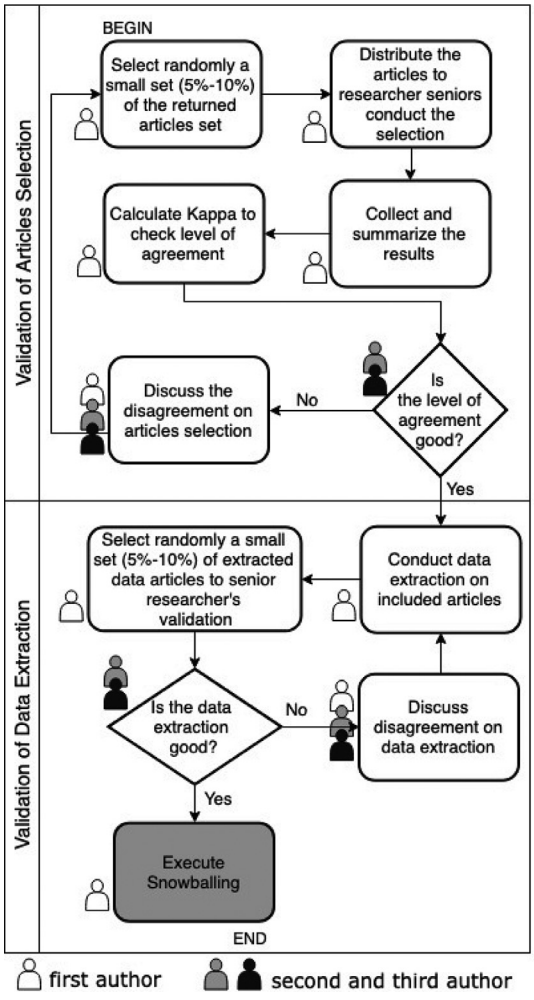

Fig. 2. Validation activities.

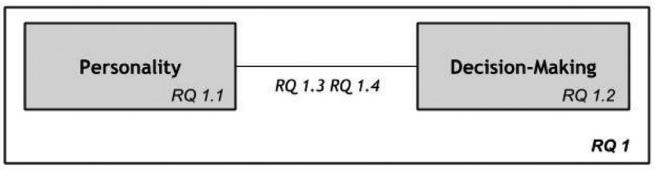

Fig. 3. Research question and sub-question's focus.

obtained at least a moderate level of agreement, represented by a kappa between 0.41 and 0.60 [14, p. 71]. Appendix C shows more details about the validation of papers' selection related-activities.

To validate the data extraction, the first author did the data extraction of 26% of the included papers (four papers) and sent the results to the second and third authors. They analyzed the extraction and judged it satisfactory.

Finally, during the reporting phase (Fig. 1), the results were checked by the second and third author. They suggested some changes which were implemented and then approved by them.

3.1. Research questions

The main Research Question (RQ) of the SLR reported here is **RQ 1. What is the relationship between personality and decision-making?** In order to answer this question, we added four sub-questions, presented in Table 1.

Fig. 3 illustrates the relationship between personality and decision-making investigated in this SLR and where the focus of each RQ is.

3.2. Search strategy

This SLR used three methods to search for papers: electronic database search, backward and forward snowballing [14]. First, we conducted an electronic database search, then we executed a backward snowballing in the previously selected articles until we could not find any additional article to be included. Finally, we conducted a forward snowballing on all included articles and then backward snowballing in the only article included in this phase. We did not find any new article in the last additional backward snowballing and because of this, we stopped our search. Fig. 4 illustrates the search process employed in this SLR.

Although it is not usual to use forward snowballing in the way we did, we decided to widen our search and increase the set of included articles. The next subsections discuss the database selection and the string construction, both related to the electronic database search phase.

3.2.1. Databases selection

Since this SLR searched for papers in a wide range of fields, we executed the following tasks for database selection:

1. Search for areas of knowledge (or fields of science) in which there is more probability to find papers that discuss the relationship between decision-making and personality considering the company

Table 1
Research Questions and their motivation.

ID	Research Question	Motivation
RQ1.1	What personality aspects and respective instrument have been identified as relating to decision-making?	Identify the personality aspects and the personality assessment instruments employed on the studies.
RQ1.2	What decision-making aspects have been identified as relating to personality?	Identify the decision-making aspects investigated in the studies.
RQ1.3	Which personality aspects are related to which decision-making aspects? How is this relationship characterized?	Identify all the relationships between personality and decision-making aspects investigated by the studies.
RQ1.4	Is there any moderating or mediating factor that has an influence on the relationship between personality and decision-making? If so, what is this influence?	Identify factors that can influence the relationship between personality and decision-making aspects.

context. In this case, we considered the classification of areas of knowledge provided by University of Oulu's library[2].
2. Look for relevant databases related to all chosen fields of science.
3. Select from the previous set of databases (see step 2), those used in one or more of the three literature reviews in which this SLR is based on [8,12,13].
4. Compare the selected databases (from step 3) with the list of databases of each field of science provided by the University of Oulu[3]. Then verify if all fields of science had at least one relevant database. If not, include at least one specific database for each not covered field.

The abovementioned steps are further detailed next: to search for areas of knowledge, we considered the classification provided by the University of Oulu Library. The selected areas of knowledge are Education and Psychology, Economic Sciences and Business Studies, Industrial Engineering and Management, and Information Processing Science. We selected these areas considering that there is a great probability to find papers that **discuss personality and decision-making relationship in the context of companies that develop any kind of product or deliver any kind of service** in these areas.

Considering the list of databases for each selected field (also provided by the University of Oulu's library) we selected the databases considering only those used in at least one of the three literature reviews in which this SLR is based on [8,12,13]. For example, EBSCOhost is used by [8] and because of this, we included this one. Scopus is used by [12,13], and because of this, we selected this other database. Only one database used by [13] was not included because it is not supported by University of Oulu: EI Compendex.

Then, we verified if there was any area that had no related database. Because of this, we realized that there was no specific database for the psychology field and we decided to include the Ovid database. Afterward, we checked for overlap between the selected databases. We run one string in all databases and, using the Parsifal tool[4], we counted the number of duplicated papers for each pair of databases. The string we used and the result we obtained are presented in Appendix A. By observing the number of duplicated articles, we verified a complete overlap between Ovid and Scopus and because of this, we excluded the Ovid database from our search.

Since Scopus database indexes many other databases, including some databases specific for the psychology field (information that came from our verification detailed above and in Appendix A), we decided to exclude the database that indexes only psychology studies (Ovid). The final set of databases used in this SLR is presented in Table 2.

The criteria that we used to select the databases are summarized below. The meaning of these criteria is explained in the text before wards as well as the strategy to ensure that we met them.

1. The database is available at the University of Oulu.

[2] http://libguides.oulu.fi/subjectguides.
[3] http://libguides.oulu.fi/subjectguides.
[4] https://parsif.al/.

Table 2
List of selected databases.

#	Database	URL
1	ACM Digital Library	http://dl.acm.org
2	EBSCOhost	http://web.b.ebscohost.com
3	IEEExplore	http://ieeexplore.ieee.org
4	Science Direct	http://www.sciencedirect.com
5	Scopus	https://www.scopus.com
6	Wiley Online Library	http://onlinelibrary.wiley.com

2. Each database on the list was used in one or more of the three literature reviews in which this SLR is based on [8,12,13].
3. A selected database cannot have a complete overlap between each other. This means that if two or more databases have a complete overlap, we need to choose one of them.

3.2.2. Search string

With regard to the search string construction, we considered the search terms used in the three literature reviews. From [8,13] we employed synonyms for personality, and from [12] synonyms for decision-making.

We used the principles of Quasi-Gold Standard proposed by [15] to check how good the string was. We evaluated the *string precision* by estimating the number of false negatives in the database that returned the lowest number of articles, and the *stringsensitivity* by verifying if the papers of the known set were returned using the created string. The known set was composed by [8,16,17]. Note that the search did not restrict the period of papers' publication, i.e. we included all the papers, regardless of when they were published.

We run the first version of the string (see Appendix B) in each selected database. Then we conducted a selection in the database with the smallest number of returned articles (Ovid) and verified many false positives. Because of this, we decided to include one more term: company and its related synonyms (Table 2). We chose this term because our SLR is focused on companies that develop any kind of product or service. We checked again in the Ovid database the number of false negatives and, since this number decreased, we decided to include this third term and its synonyms. Then we checked if it was possible to retrieve the articles of the known set. Since it was, we concluded that the string was good enough. Appendix B shows the number of articles that each database returned using the two versions of search strings. Table 3 shows the keywords and their related search terms, and the final string.

3.3. Selection strategy

The activities proposed for papers selection are presented in Fig. 1, around the middle of it, on executing phase. The inclusion and exclusion criteria are presented in Table 4.

Table 3
Search term and search string.

Keyword	Search Term
Personality	personality, extroversion, emotional stability, locus of control, agreeableness, conscientiousness, openness, psychological typology, psychological types, temperament types
Decision-Making	decision making, decision-making, decision theory, decision model
Company	company, enterprise, team, work group, industry, organization, business environment
Final String: (personality OR extroversion OR emotional stability OR "locus of control" OR agreeableness OR conscientiousness OR openness OR "psychological typology" OR "psychological types" OR "temperament types") AND ("decision making" OR "decision-making" OR "decision theory" OR "decision model") AND (company OR enterprise OR team OR "work group" OR industry OR organization OR "business environment")	

Table 4
Inclusion and exclusion criteria.

Inclusion Criteria
IC 01 - The paper describes empirical studies about the relationship between personality and decision-making in the context of companies that develop any kind of service or product.
IC 02 - The paper is peer-reviewed, and it is a full paper.
IC 03 - The paper is written in English.
IC 04 - The full text of the article is available.
Exclusion Criteria
EC 01 - The publication is not peer-reviewed or it is not a full paper (abstract or short paper i. e. paper with less than 4 pages).
EC 02 - The paper is not written in English.
EC 03 - The full text of the paper is not available.
EC 04 - The paper presents a literature review, lessons learned, or it is an opinion article, in other words, it is not an empirical study.
EC 05 - The paper does not study the relationship between personality and decision-making.
EC 06 - The paper is not in the context of companies that develop any kind of service or product.
EC 07 - The paper discusses a variable that can be considered a personality aspect, but the paper does not deal with it using a personality theory.

Table 5
Quality assessment criteria (adapted from [25]).

Screening Questions ***(If question 1, or both of questions 2 and 3, receive a "NO" response do not continue with the quality assessment)***
1. Is the paper based on research (or is it merely a "lessons learned" report based on expert opinion)?
2. Is there a clear statement of the aims of the research?
3. Is there an adequate description of the context in which the research was carried out?
Detailed Questions
(1 point given for each "YES", 0.5 for each "PARTIALLY", and 0 for each "NO")
Research Design: 4. Was the research design appropriate to address the aims of the research?
Sampling: 5. Was the population selected for the study appropriate to the aims of the research?
Data Collection: 6. Was the data collected in a way that addressed the research issue?
Data Analysis: 7. Was the data analysis sufficiently rigorous?
Reflexibility: 8. Has the relationship between researcher and participants been considered to an adequate degree?
Findings: 9. Is there a clear statement of findings?
Value of Research: 10. Is the study of value for research or practice?

In relation to the retrieved papers, we read their titles and abstracts resulting in a set of pre-selected articles. Then the full text was checked, resulting in the set of included articles.

With regard to the exclusion criterion EC-04, the study presented in [18] is a good example of article excluded because of this criterion. The paper reviews some concepts related to personality and decision-making, and based on the literature review and the author's experience, proposes some insights about the relationship between personality and decision-making; however, no empirical evidence is provided.

EC-05 is illustrated in [19] paper. The authors collected information about decision-making and characterized the personality of the sample using the Myers-Briggs Type Indicator (MBTI) instrument; however, they did not draw any conclusion about the relationship between personality and decision-making.

The paper [20] was excluded because of EC-06. It discusses the relationship between personality and decision-making, however, the simulation scenario was related to a naval command or control task or hospital task.

Finally, [21] was the only study that we excluded due to EC-07. This paper discusses the relationship between some strategical decision making process characteristics and entrepreneurial characteristics. Some of the entrepreneurial characteristics can be argued as a personality aspect, for example, need of achievement. However, for some others, we could argue it is not a personality aspect, for example, competitiveness. The authors do not bring any discussion in clarifying this point, and they use the generic term "psychological and cognitive characteristics of entrepreneurial" to name all the characteristics. Since the authors do no deal with these characteristics clearly as a personality aspect we decided to exclude this paper.

3.4. Quality assessment

We compared three different methods to evaluate the quality of the included articles. The study presented in [22] reviews how quality assessment is conducted in SE and presents a proposal to assess the quality of studies that includes four dimensions: context, design, interpretation, and presentation of results. They suggested eleven questions, three on context dimension, five on design dimension, and one for each remaining dimension. However, a forward snowballing showed that this checklist has not been used in any SLR study to date.

The literature review reported in [23] presents a model to evaluate the rigor and relevance of technology evaluations in SE. Rigor is related to the quality of the research method used, and relevance is the impact of the publication for the community. Despite this model is widely used in many SLRs, it has been criticized because of its subjectivity (different researchers can apply this model to the same sample and get different results) and because the criteria related to relevance (the model does not evaluate important aspects of the industry) [24].

Another alternative for quality assessment is to use the criteria proposed in [25]. These criteria seem to be the less subjective of all that we analyzed; furthermore, they have been used in many SLRs [26–29] and they focus on analyzing the strength of the evidence presented by the publication. We used this one, but we excluded the criterion related to control group because it is specific for formal experiments. We also rewrote the criteria related to sampling. The criteria that we used are presented in Table 5.

For each criterion in the Detailed Question section (Table 5), the possible answers were: yes, partially or no. The "yes" answer added 1.0 in the total score of the evaluated paper, the "partially" added 0.5, and "no" added zero, therefore the maximum possible score is 7.0. All papers scored equal or less than 3.5 (half of the maximum score) were excluded from this SLR due to the poor quality.

3.5. Data extraction

Appendix E presents the template of the form used to extract information from the included papers and the related research question for each item. The extraction form has three items related to paper identification, one related to the research method employed, five related to the study context, and one item for each research question. The items related to the study context were based on guidelines presented in [30] and they were used to help on interpreting the findings.

The extraction was conducted by the first author, and the other two authors checked a sample of the extraction result (26% of the included articles, 4 articles). The validation activities are presented in Fig. 2.

3.6. Data synthesis

The data synthesis concentrated on general analysis and on answering the research questions. The indicators for general analysis group are number of retrieved and included studies per search phase; number of studies (total and included) per database; number of included studies per year; number of included studies per type (experiment, case study, survey or mixed types); list of venues where the studies were published; and quality assessment score for each included study.

The second group contains indicators for each research question. The indicators are presented in Table 6.

4. Results

We identified 15 primary studies that discuss the relationship between personality and decision-making. The included papers are listed in Appendix D; the identifiers presented in that list will be used to refer to each included paper henceforth.

The remaining of this section is organized as follows: the indicators related to the research method execution are presented in Section 4.1. Section 4.2 characterizes the studies, and Section 4.3 answers the research questions.

4.1. Research method execution

This SLR was planned and executed from April to November 2017. The Planning phase started in April 2017 and the Execution phase in June 2017. We run the strings on the electronic databases in June 2017; the backward snowballing was executed in September 2017, and the forward snowballing in November 2017.

Fig. 4 illustrates the search process and the number of studies analyzed per search phase and the number of included studies per phase. The total of analyzed studies were 3814, considering all searching phases. The backward snowballing was executed until saturation, in other words, until it was not possible to include more studies in this SLR.

More than 50% of the included studies (8 of 15) came from electronic databases searching phase, therefore this was the most efficient phase. The less efficient phase with less number of included studies was forward snowballing despite the analysis of the highest sample of studies. However, there is no problem with this, since the goal of the snowballing is to complement the primary search phase.

Fig. 5 presents a summary of the electronic database searching phase. Note that most of the databases did not return any relevant studies; in fact, only two of the six databases returned studies that we included in this SLR: EBSCOhost (1) and Scopus (7).

EBSCOhost is a database with many venues related to the Management field and SCOPUS is a database that indexes many other databases. Probably, because of this, these two databases were those that returned some useful studies.

We initially included 44 studies based on screening of the titles and abstracts. However, after checking the full text, most of them were excluded (check Section 3.3 to see some examples of excluded articles).

In order to verify if we covered all important databases, for each included paper, we used Google Scholar to identify in which database each the paper could be found. Table 7 shows the result of this above-mentioned analysis.

The databases that are different from the set of selected databases used in this SLR are AIS Electronic Library, APA PsycNet, Connecta, Emerald Insight, Infona, Ingenta JSTOR, Proquest, Taylor&Francis. Among these databases, some are indexed by Scopus and EBSCOhost, for example, AIS, Emerald Insight, Ingenta, and Proquest. Others are not listed on University of Oulu e-database library (criterion 1, Section 3.2.1), for example, APA PsyNet and Taylor&Francis. Considering these observations and the snowballing we executed, we believe that the searched conducted in this SLR covered sufficiently the amount of work available about the target subject.

Table 6
List of indicators of each research question.

Description of the Indicator	RQ
Personality Aspects - Table with the personality aspects considered in each paper and the framework related to them.	1.1
Personality Tests/Instruments/Models - List of personality instruments with the number or percentage of paper for each one. Track the source of them.	1.1
Decision-Making Aspects - Table with the decision-making aspects considered in each article and the model related to them. Track the source.	1.2
Personality Aspects X Decision-Making Aspects - Table crossing the list of personality aspects and decision-making aspects. The intersection between row and column will contain the type of relationship identified between personality and decision-making aspect. Track the source.	1.3
Other variables that influence on the relationship between personality and decision-making - List of variables that influence the observed relationship with the type of influence. Track the source.	1.4

Table 7
Included articles versus Databases.

ID	Databases where the article can be found
S1	EBSCOhost, Proquest
S2	Scopus, Emerald Insight, Ingenta
S3	Emerald Insight, Scopus
S4	Emerald Insight, Scopus
S5	AIS Electronic Library, Scopus
S6	Taylor& Francis, Scopus
S7	APA PsycNet, Emerald Insight, Ingenta Connect, Scopus
S8	Elsevier, Infona, Scopus
S9	Wiley, Ingenta
S10	ACM, EBSCOhost, JSTOR
S11	Wiley
S12	Willey, Ingenta
S13	Elsevier
S14	Scopus
S15	Emerald Insight, Ingenta

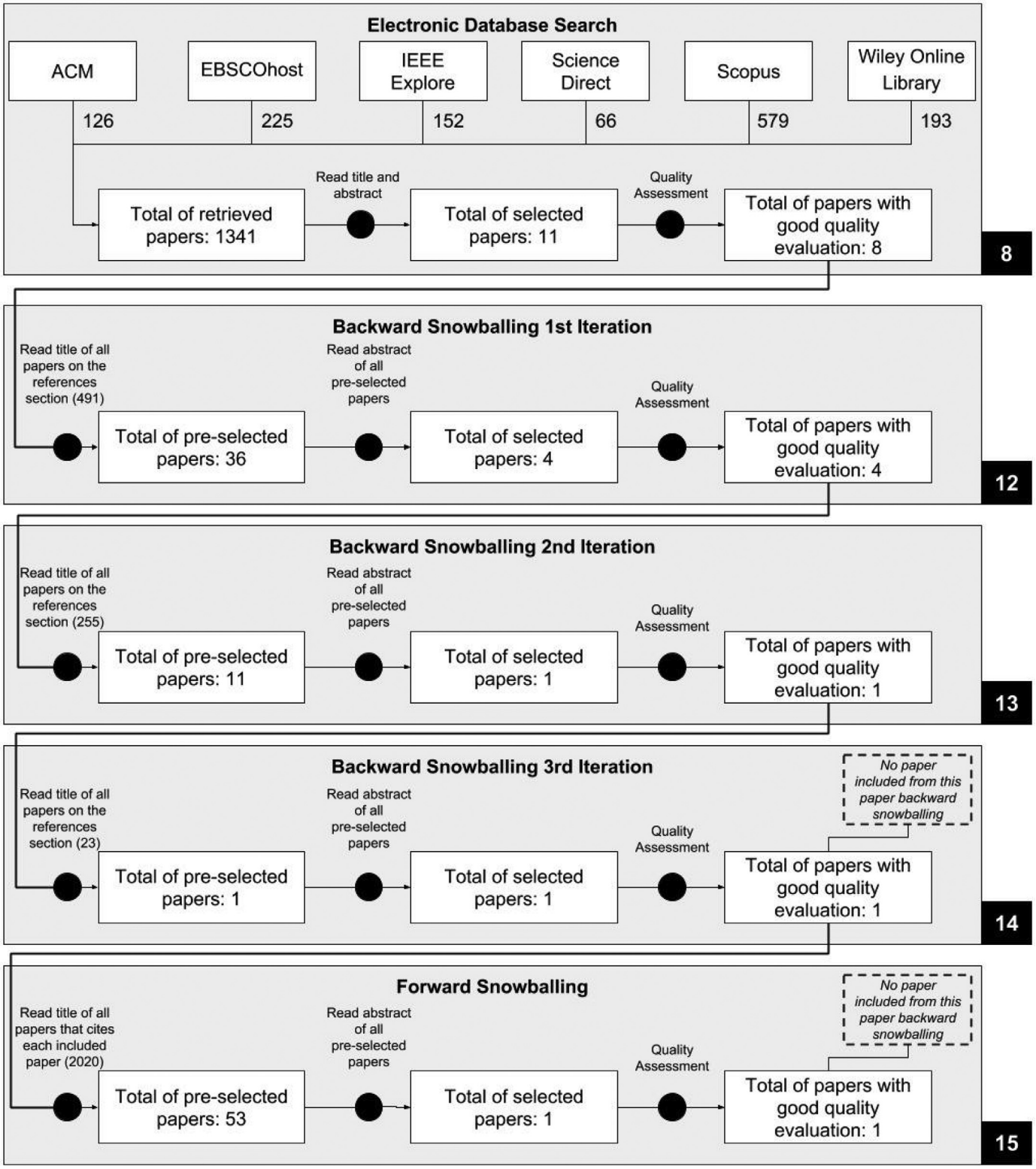

Fig. 4. Search process with numbers.

4.2. Overview of the studies

This section will present an overview of the included studies considering the year of publication, authors, type of study and venues.

4.2.1. Temporal view of the included studies

Fig. 6 presents the temporal distribution of the studies included in this SLR. Note that 20% of the included papers were published in the 80's and 80% after 2002. Observe also that there is no publication between 1990 and 2001.

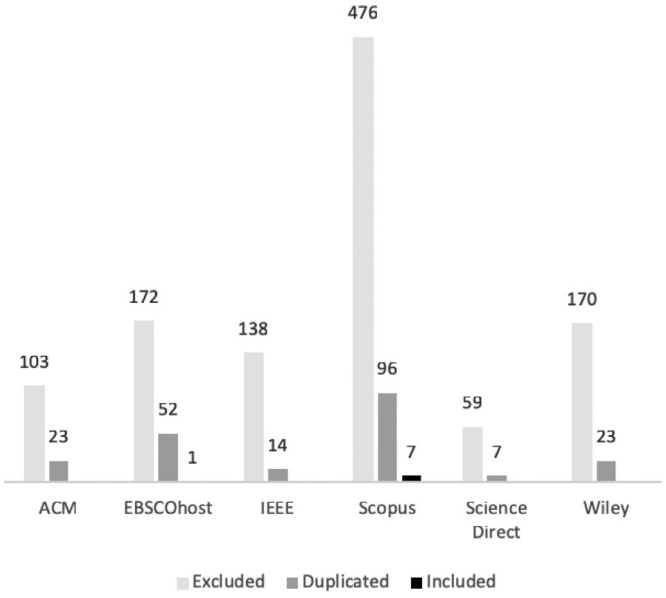

Fig. 5. Number of studies per database.

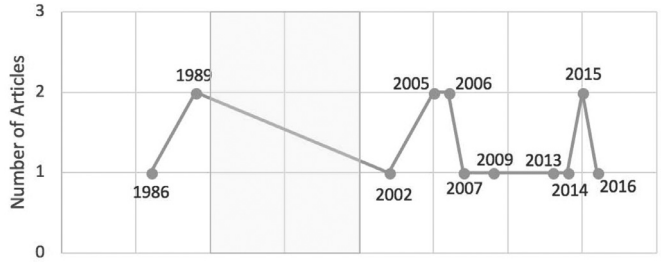

Fig. 6. Temporal distribution of the included articles.

The studies published during the 80's were found through backward snowballing and all of them are from the Management field. Two of these three articles discuss personality as cognitive style and use the framework MBTI to assess personality.

The papers published after 2001 employed many different personality instruments and discuss many different decision-making aspects. Note that the years 2003, 2004, 2008 and 2010–2012 have no publications. Despite this, it is possible to conclude that the interest in this topic grew after 2002. These many years without publications led us to investigate the reasons for it. The next subsection will show an attempt to explain it.

4.2.2. Researchers and motivation for the research

By analyzing the included papers, we found out that except for the author Vassilis Papadakis (who had two papers that we included in this SLR S3 and S12), all the other authors published only one paper about the relationship between personality and decision-making. Because of this, we developed two hypotheses that could explain it: (1) the papers were a result of PhD research and after the PhD the authors did not investigate this subject again; (2) the research that resulted in the paper was funded and when the funding ended the research ended too.

In order to check whether our hypotheses would make sense, we checked the acknowledgments section of all the included papers for any information about financial support for the research, and we also checked the curriculum vitae of the first author (when available) in order to verify if the paper is part of his/her PhD research. With regard to research motivation, only three studies mentioned any financial support (studies S9, S10, and S11). Furthermore, in the curriculum vitae of the first authors that we could recover, we found that only two studies were part of a PhD research (studies S7 and S11). Therefore, we did not find evidence to support none of our hypotheses.

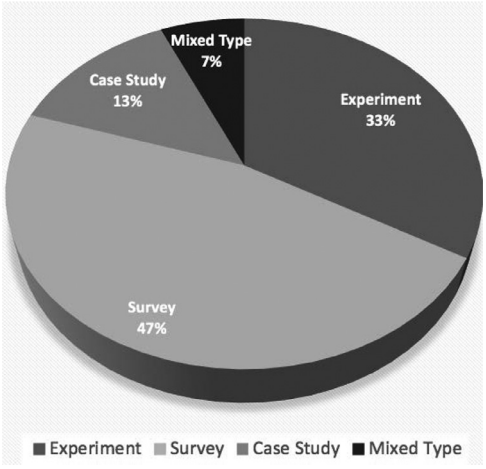

Fig. 7. Type of study of the included articles.

4.2.3. Types of studies

With regard to the type of study, results showed that case studies, surveys, experiments, and mixed types were employed. However, most of the papers used either a survey (47%, 7 papers) or an experiment (33%, 5 papers) as a research method (see Fig. 7).

The only paper classified as "mixed types" was S4 because the authors conducted both a case study (qualitative study) and a survey (quantitative study). The papers S2 and S8 conducted case studies and both employed interview and questionnaire to collect data.

It is important to highlight that we are using here the research method's name that the authors claimed that they employed. However, in some cases, we found out that the authors did not use the method that they claimed, especially in the case of experiments. According to [31], a controlled experiment is about manipulating variables and, based on randomization, to set different treatments for different subjects. When it is not possible to choose the subjects for different treatments based on randomization, then this is called *quasi-experiment*. Therefore, according to this author, the randomization is a crucial aspect of planning and executing an experiment. However, none of the papers that claimed to use experiments as a research method mention the randomization aspect and some of them did not even mention explicitly the variables under study, i.e. dependent and independent variables [S5, S9, S11, and S13]. However, they employed some statistical analysis typical for an experiment, for example, Chi-Square Test [S3, S9], ANOVA [S13] and T-Test [S11]. According to the information presented before and the definition of experiment provided in [31], we would classify most of these papers as *quasi-experiment* rather than controlled experiment.

4.2.4. Venues

In relation to the venues where the primary studies were published, most of them were published in journals (93%, 14 studies). The journals and conference names where the primary studies were published are listed in Table 8.

All journals are from the business and management field and the journal with the highest number of papers is focused on decision-making. In the conference list, we can find only one paper and the venue is from the Information Systems field.

4.2.5. Quality assessment

As discussed in Section 3.4, we used the criteria defined in [25] with some modifications to assess the quality of the primary studies. Such criteria have 10 questions; however, the maximum possible score is seven, because three questions do not score (refer to Section 3.4 for more details). For each question that adds to the final score, there were three possible answers and three possible scores: yes (1.0 point), partially (0.5 points) and no (0). Fig. 8 shows a summary of the quality assessment.

Table 8
List of journals and conferences.

Journal	# Articles	References
British Journal of Management	1	S12
International Journal of Applied Business and Economic Research	1	S14
International Journal of Managing Projects in Business	1	S4
International Studies of Management & Organization	1	S6
Journal of Business and Management	1	S1
Journal of Management Studies	2	S9, S11
Management Decision	5	S2, S3, S7, S8, S15
Management Science	1	S10
Organizational behavior and human decision processes	1	S13
Conference	**# Articles**	**References**
European Conference on Information Systems (ECIS)	1	S5

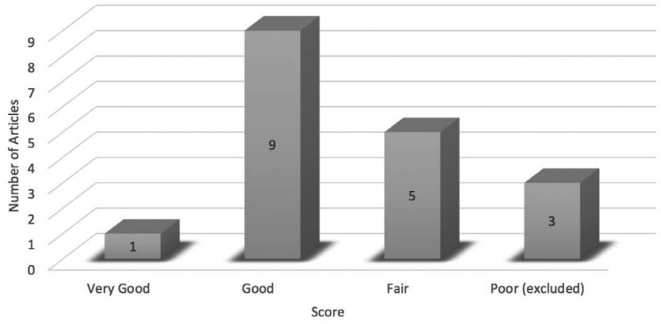

Fig. 8. Quality assessment results
Note: score ≥ 6.1: very good; score ≤ 6 and > 5: good; score ≤ 5 and > 3.5: fair; score ≤3.5: poor (all articles bellow 3.5 score were excluded, i.e. 50% of the highest score).

Most of the included papers achieved good quality and were not assessed as very good because they failed to mention the research threats related to the relationship between researcher and subjects. Such threats to validity are important to be discussed, so one knows if the data collected is free of bias (or if the authors evaluated the bias) related to the interaction between researcher and subjects, in other words, bias related to the data collection.

Three papers were excluded because of poor quality, one was found during e-database searching, another one during the third iteration of backward snowballing and another one during forward snowballing (see Appendix F to get the full reference of them). These papers did not analyze properly the data they collected, this means that they have data that could say something about the studied relationship, but the authors did not conclude about the relationship. These papers presented also the same problem of the articles classified as ***good*** i.e. they failed to discuss the relationship between researcher and subjects, among other problems. Appendix F shows the details related to the quality assessment of each paper, including those we excluded.

4.3. Answers to research questions

We extracted and aggregated data from the 15 included studies in order to answer the research question: **What is the relationship between personality and decision-making?** Observe that the detailed answer to this main question is given by answering the related sub-questions RQ 1.1, 1.2, 1.3 and 1.4. However, in relation to this main question we can conclude that (1) there is a relationship between decision-making and personality; (2) the relationship between personality and decision has been characterized in different ways, depending on the personality assessment instrument employed; (3) there is no standard way to measure decision-making aspects; and 4) few studies explored mediating/moderating factors.

Table 9
Identified instruments and related personality aspect.

Instrument	Personality Aspect	References
Five	Extroversion	S5, S8, S14
Factor	Agreeableness	S5, S8, S14
Model	Conscientiousness	S8, S14
	Neuroticism	S5, S8, S14
	Openness	S8, S14
Myers-Briggs	Sensing/Intuition	S9
Type	Thinking/Feeling	S9
Instrument	Extro/Introversion	S9
	Judging/Perceiving	S9
	Sensing-thinking type	S11
	Intuition-thinking type	S11
	Sensing-feeling type	S11
	Intuition-feeling type	S11
	Analytic	S1, S13
	Intuitive	S1, S13
	Mixed Types (Analytic and Intuitive)	S13
Steers and	Need of	S3, S10, S12,
Braunstein	Achievement	S15
Instrument		
Business-focused	Flexibility	S7
Inventory of	Achievement	S7
Personality	Motivation	
	Networking Abilities	S7
	Action Orientation	S7
Flexibility scales of the California Psychological Inventory	Flexibility	S10
Rotter's locus of control instrument	Locus of Control	S2, S3, S10
Jackson Personality Inventory + Eysenck and Eysenck Instrument	Risk Propensity	S3, S13
Hyrsky and Tuunanen Instrument	Risk Attitude	S15
No Mention	Personality	S4
of Personality	differences	
Instrument	Diversity in personality	S6

The list of personality aspects and the related instrument is shown in the RQ 1.1 section. The decision-making aspects and our proposed classification are provided in the RQ 1.2 section. All the reported relationships and their characterization are presented in the RQ 1.3 section; finally, the moderating and mediating variables that influence the relationship between personality and decision-making aspects are given in the RQ 1.4 section.

RQ 1.1. What personality aspects and respective instrument have been identified as relating to decision-making?

This SLR identified 28 different personality aspects measured by eight different instruments. An overview of each identified personality assessment instrument is presented in Appendix G. Table 9 lists the instruments, the related personality aspects and the included papers that used them.

The most used instruments were MBTI and Steers and Braunstein Instrument (four studies each one), followed closely by Five Factor Model (FFM) and Rotter's locus of control instrument (three studies each one). Although there are four different studies that used the MBTI instrument, each paper employs the instrument in a different way. Study S9 compares dichotomies of personality type relating them to a decision-making aspect; paper S11 chose some specific personality types to

Table 10
Identified decision-making aspects.

Class	Entity	Attribute	References	Description*
Decision-Making	Characteristics	Decision Making Efficiency	S1	The time consumed to perform the decision-making tasks
		Cognitive Conflict	S6	It is a disagreement about the content of the tasks being performed, including differences in viewpoints, ideas, and opinions
		Decision Quality	S8, S9	It is related to how "good" the decision is
		Perceived Decision Effectiveness	S9	How each person sees his/her own ability implement a decision
		Decision-making time span	S10	The time impact of a decision (short or long term)
Decision Maker	Characteristics	Confidence	S5	It is the level of belief of a decision maker about the desired outcome
		Creativity	S6	It is related to the number of ideas generated by a decision-maker
		Decisiveness	S9	The total number of problems addressed by an individual manager during the course of the simulation was used to indicate a manager's decisiveness)
		Analysis style	S10	The analysis style of a decision maker, for example, intuitive, analytical or informal
		Proactiveness style	S10	How the decision maker acts during a decision, for example, reactive or proactive
		Risk Taking style	S10	How the decision maker faces a known risk: taking it, avoiding it or in a neutral way
	Decision Biases	Input biases	S11	The decision biases are related to a cognitive ability
		Output biases	S11	that can culminate in inferior decisions. Input, out-
		Operational biases	S11	put and operational biases are related a when (during a decision-making process) the biases can occur
	Decision styles	General	S4	Indicates the way decisions are made and imple-
		Analytic Decision	S13	mented
		Intuitive Decision	S13	
		Mixed Type Decision	S13	
		Participative	S2	
		Group Consultive	S2	
	Orientation	Profit and Environmental	S14	The decision orientation is related to what the deci-
		Cultural Orientation	S14	sion-maker considers important during a decision-
		Sustainability Orientation	S14	making
Strategic Decision-Making	Process Characteristics	Comprehensiveness/ Rationality	S3, S12, S15	It is a measure of how rational a decision maker is, considering five steps of the decision-process: (1) situation diagnosis, (2) alternative generation, (3) alternative evaluation, (4) making of the final decision and (5) decision integration
		Hierarchical Decentralization	S3, S12	It is related to the total amount of participation of various hierarchical levels and departments in each phase of the decision process.
		Lateral Communication	S3, S12	The degree of balanced participation of all major departments in the adopted five stages of the process.
		Politicization	S3, S12, S15	It measures the extent of coalition formation, the degree of negotiation taken place among major participants, the degree of external resistance encountered and the degree of process interruptions experienced.
	Mediating Process	Timing of agenda setting	S7	Related to the time that the team takes to define an agenda (early or late)
		Number of strategic alternatives	S7	Related to the number of alternatives generated by the team during a decision-making (many or few)
		Strategic decision-making speed	S7	Related to how fast is a team to make a decision (fast or slow)

* The description was inspired or, in some cases,we took it directly from the article that uses this decision-making aspect.

conduct the analysis (see Table 12), and papers S1 and S13 chose one specific category to focus their research. The studies that used Steers and Braunstein Instrument, on the other hand, was used in a homogeneous way, i.e. it was used to characterize some specific trait personality and make conclusions relating to some decision-making aspect.

About the personality aspects, the most investigated personality aspects are **need of achievement** (four studies); and **agreeableness, extroversion, neuroticism, and locus of control** (three studies each one). Need of achievement was measured by one of the most referenced instruments: Steers and Braunstein Instrument. Agreeableness, extroversion, and neuroticism are traits measured using the FFM instrument, and locus of control was measured by Rotter's instrument.

Two studies did not mention any instrument from psychology science and investigated personality in a general way (S4 and S6). S4 and S6 studied people perception of some personality aspect and defined their own way to calculate the aspect of personality that they were studying.

RQ 1.2. What decision-making aspects have been identified as relating to personality?

In order to better understand the decision-making aspects discussed by the included studies, we decided to aggregate the aspects in classes, entities, and attributes, using the guidelines presented by [32] and according to the model defined by [33, chap. 1 and 3]. The aggregation is presented in Table 10 with a brief description of each attribute and the references where the decision aspect is discussed. This aggregation was discussed and approved by the authors of this paper in order to prevent bias. The term attribute is also referred in this paper using the word "aspect".

The **decision-making class** is related to the decision, as the output of a decision-making process. The **decision-maker class** refers to all items related to the person who makes the decision. It has four entities: characteristics, decision biases, decision style, and orientation. The **strategic decision-making class** aggregates the process and mediating process of strategic decisions.

Table 11
Number and percentage of relationships per personality aspects and per decision-making aspect.

Personality Instruments	# Relationships	Percentage
Myers-Briggs Type Indicator	22	29.33%
Five Factor Model	12	16.00%
Business-focused Inventory of Personality	12	16.00%
Rotter's locus of control instrument	7	9.33%
Steers and Braunstein Instrument	6	8.00%
No Specific Model	6	8.00%
Jackson Personality Inventory + Eysenck and Eysenck Instrument	4	5.33%
Flexibility scales of the California Psychological Inventory	4	5.33%
Hyrsky and Tuunanen Instrument	2	2.67%
Decision-Making Aspects	**# Relationships**	**Percentage**
Decision Maker	38	50.67%
Strategic Decision Making	24	32.00%
Decision Making	13	17.33%

The class with the largest number of studies is decision-maker (9 studies), followed by decision-making (5 studies), and strategic decision-making (4 studies).

About the attributes mostly studied, politicization and comprehensiveness/rationality have three studies each one; and hierarchical decentralization and decision quality have two studies each one. These numbers show that few studies research the same decision-making aspect.

RQ 1.3. Which personality aspects are related to which decision-making aspects? How is this relationship characterized?

The total amount of identified relationships between personality and decision-making aspects is 75. To reach such a number, we created a table with all identified personality and decision-making aspects, we filled the cells with the references that reported some relationship, and we count the number of not empty cell for each intersection between personality and decision-making aspect. If we consider only the personality instruments, the instrument with the highest number of reported relationship is MBTI, followed by FFM and Business-focused Inventory of Personality (see Table 11). Considering only the decision-making aspects, the decision-maker class contains the highest number of relationships (see Table 11).

Authors studied the relationship in three quantitative ways: (1) comparing two or more personality aspects (13 reported relationships), (2) calculating the percentage for each personality aspect (8 reported relationships), and (3) verifying if the relationship is positive, negative or neutral (52 reported relationships).

Among this last and larger group of relationships, there is only one relationship reported as neutral/non-existent (0), 17 that report a negative relationship between a personality and decision-making aspect (−), and 33 that report a positive relationship (+). Only one study analyzed the relationship qualitatively (S7), representing three relationships (3.94%).

All these abovementioned relationships are shown in Tables 12–15, arranged by personality instrument. Along the reference where the relationship can be found, there is also a sign that characterizes the relationship. The meaning of each sign is explained with the instrument related to it.

The total number of relationships using **MBTI instrument** is 22. Table 12 shows all reported relationship for this instrument. The MBTI instrument was used in four different ways:

1. **Comparing dichotomies of personality aspects**. This kind of study is indicated in Table 12 with the words *"higher than"* or *"no diff"*. **X *higher than* Y** means that the personality type X has a higher impact than Y on the studied decision-making aspect. The words ***no diff*** mean that there is no difference in the

Table 12
Reported relationship using MBTI instrument.

Personality Aspect X Decision-Making Aspect			Thinking/ Feeling	Extroversion/ Introversion	Judging/ Perceiving	Sensing-thinking type	Intuition-thinking type	Sensing-feeling type	Intuition-feeling type	Analytic	Intuitive	Mixed Types (Analytic and Intuitive)
Decision-Making	Characteristics	Decision-Making Efficiency								+/−* [S1]		
		Decision Quality				>[S9]	>>>[S9]	>[S9]	>>[S9]			
		Perceived Decision Effectiveness	T higher than F [S9]	E higher than I [S9]	No diff [S9]							
Decision-Maker	Characteristics	Decisiveness		No diff [S9]	No diff [S9]	>>[S9]	>>>> [S9]	>[S9]	>>> [S9]			
	Decision Biases	INPUT Anchoring					82% [S11]					
		INPUT Perseverance						91% [S11]				
		INPUT Availability							80% [S11]			
		OUTPUT Functional Fixedness					36% [S11]					
		OUTPUT Positivity						36% [S11]				
	Decision styles	Analytic Decision								46% [S13]		
		Intuitive Decision									56% [S13]	
		Mixed Type Decision										36% [S13]

* Depending on the problem structure (if well structured, the relation is positive, if ill-structured the relation is negative).

Table 13
Reported relationship using FFM instrument.

	Personality Aspect X Decision-Making Aspect		Extroversion	Agreeableness	Conscientiousness	Neuroticism	Openness
Decision-Making	Characteristics	Decision Quality					+[S8]
Decision-Maker	Characteristics	Confidence	−[S5]	−[S5]		−[S5]	
	Orientation	Profit and Environmental Orientation		−[S14]	−[S14]		−[S14]
		Cultural Orientation	+[S14]			+[S14]	
		Sustainability Orientation		+[S14]	+[S14]		+[S14]

impact of each personality aspect in the studied decision-making aspect.

2. **Comparing two or more different MBTI personality styles in relation to their impact on some decision-making aspect.** This kind of study is presented in Table 12 using the sign ">". In the same line, it is possible to see some cells with one or more of these signs. The higher the number of ">" signs, the higher is the strength between MBTI type with regard to decision-making aspects it relates to.
3. **Percentage of MBTI personality types in relation to a decision-making aspect.** In this case, the study just counts the total number of people and the number of people with some MBTI personality type that has some decision-making style or presented some decision bias.
4. **Positive or negative relationship between a personality and decision-making aspect.** In this case, the study applied some statistical techniques to verify the correlation between the personality and decision-making aspect. These cases are presented in Table 12 with the signs + (positive relationship between the personality and the decision-making aspect), − (negative relationship) or 0 (no correlation could be found).

The most studied decision-making aspects are decisiveness (6) followed by decision quality (4) and perceived decision effectiveness (3). The personality aspects mostly studied are the sensing-thinking (4) and intuition-thinking (4) types, followed by sensing-feeling type (3). All these relationships are shown in Table 12.

The MBTI defines 16 different personality types, considering the four dichotomies, however, none of the studies used the instrument considering one or more of these 16 types. Maybe the reason behind this is the complexity that the combination of the dichotomies can bring to the study.

The **FFM instrument** was used to study 12 relationships in 3 different studies. Table 13 shows all reported relationships for this instrument. Other than MBTI, FFM was used in only one way: positive (+) or negative (−) relationship between a personality and decision-making aspect.

The decision-maker class has 11 investigated relationships, and the decision-making class has only one. Regarding personality aspects, each one has or three (agreeableness and openness) or two (extroversion, conscientiousness, and neuroticism) relationships. Note that only agreeableness and neuroticism have a negative relationship with a decision-making aspect.

About the decision-making aspects, decision quality was investigated only considering the relationship with openness. Therefore, there is a gap in the impact of the other traits in this decision-making aspect. For the other decision-making aspects studied using FFM, it was reported the relationship for at least three FFM personality traits, however, it would be interesting to check the relationship with the remaining traits.

Business-focused Inventory of Personality (BIP) also has 12 relationships but all of them are from the same study (S7), and most of the studied relationships are valid only when the team has a similar degree of personality diversity. All the relationships for this instrument are shown in Table 14. Note that this

Table 14
Reported relationship using Business-focused Inventory of Personality and Steers and Braunstein Instruments.

Personality Aspect X Decision-Making Aspect			Business-focused Inventory of Personality				Steers and Braunstein Instrument
			Flexibility	Achievement Motivation	Networking Abilities	Action Orientation	Need of Achievement
Decision Making	Characteristics	Decision-making time span					+[S10]
Decision Maker	Decision Style	Analysis style					+[S10]
		Proactiveness style					+[S10]
		Risk taking style					0[S10]
Strategic Decision	Mediating Process	Timing of agenda setting	+ [S7]*	+ [S7]*	+ [S7]*	− [S7]*	
		Number of strategic alternatives	+ [S7]*	+ [S7]*	+ [S7]*	− [S7]*	
		Strategic decision-making speed	+ [S7]	+ [S7]	+ [S7]	+ [S7]	
	Process Characteristics	Lateral Communication					−[S12]
		Politicization					+[S15]

* The relationship is valid only when the team has a similar degree of personality diversity.

instrument was studied in only one way: positive (+) or negative (−) relationship between a personality and decision-making aspect.

BIP describes 14 characteristics classified into four different areas. However, only four of these characteristics were studied. Therefore, there is a gap if we consider all the characteristics proposed by BIP and more research using this instrument is necessary.

The **Steers and Braunstein Instrument** has six relationships and all of them were reported as positive (+), negative (−) or neutral/non-existent (0) relationship. Table 14 presents all the relationships for this instrument. All the reported relationships for this instrument are between need of achievement and some decision-making aspects. However, this instrument also measures other three personality aspects: affiliation, autonomy, and dominance. Considering this information, there is a research gap in regard to the other personality aspects. Another important point to highlight is that all decision-making aspects have the same number of reported relationships.

We also identified **other personality instruments**: Flexibility scales of the Californian psychological inventory, Rotter's locus of control instrument, Hyrsky and Tuunanen Instrument, and Jackson Personality Inventory + Eysenck and Eysenck instrument. The relationships are shown in Table 15. All relationships showed are either positive (+) or negative (−).

The California Psychological Inventory has 20 different personality core scales, however, only flexibility is investigated. Jackson Personality Inventory has 15 different scales and Eysenck and Eysenck Instrument is about three different personality dimensions, however, only risk propensity is explored. About Hyrsky and Tuunanen Instrument, it also contains items related to innovativeness, however, only risk attitude is investigated. For all these instruments, other personality aspects could be investigated.

We found three papers that did **not mention any specific personality assessment instrument.** The six relationships are shown in Table 15, in the last three columns. The three aspects investigated were Personality (S7), Personality Differences (S4) and Personality Diversity (S6).

The study S7 employed BIP and added to their results some general conclusion considering the personality as a significant variable. In S4 the personality differences are calculated through a questionnaire, but the authors did not provide detail about the questionnaire or instrument used. Finally, in study S6, the personality diversity was calculated by asking the subjects to evaluate the board members diversity with regards to personality (different degree of creativity, orientation on action, and attitude to listening).

RQ 1.4. Is there any moderating or mediating factor that has an influence on the relationship between personality and decision-making? If so, what is this influence?

Only four studies [S1, S6, S7, S8] reported a moderating (affects the strength of the relationship) or mediating (intermediary variable between the main relationship) factors on the relationship between personality and decision-making. In total, the studies reported four variables: problem structure, board member's interaction, a similar degree of team diversity and psychological empowerment that have an effect on the relationships between some personality and decision-making aspects, two of them as mediating and the other as moderating the relationship.

The **problem structure** variable is related to the decision that someone needs to make. Each subject received three tasks and each task had one problem (one well-structured, one mid-structured and one ill-structured). These classifications are the values that the variable problem structure could receive. Fig. 9 shows the moderating factor of problem structure variable reported in [S1]. It is possible to notice that a well-structured problem affects positively the relationship between rational personality and decision-making and an ill-structured problem affects negatively.

About the variable **Board Member's Interaction** (BMI) during a decision-making process, the decision-makers need to interact. The

Table 15
Reported relationships using many different instruments and no mention of personality instrument from Psychology field.

Personality Aspect X Decision-Making Aspect			Flexibility scales of the Californian psychological inventory	Rotter's locus of control instrument	Hyrsky and Tuunanen instrument	Jackson Personality Inventory + Eysenck and Eysenck instrument	No mention of personality instrument from Psychology field		
			Flexibility	Locus of Control	Risk Attitude	Risk Propensity	Personality	Personality Differences	Personality Diversity
Decision-Making	Characteristics	Decision-Making time span	+[S10]	−[S10]					
		Cognitive conflict							+[S6]
Decision-Maker	Characteristics	Confidence							+[S6]
		Creativity							+[S6]
		General						+[S4]	
	Decision-Maker	Analysis style	−[S10]	−[S10]					
		Proactiveness style	−[S10]	−[S10]					
		Risk Taking style	+[S10]	−[S10]					
		Participative		+[S2]					
		Group Consultive		+[S2]					
Strategic Decision Making	Process Characteristics	Comprehensiveness/ Rationality			+[S15]	+[S12]			
		Hierarchical Decentralization				+[S3,S12]			
		Lateral Communication				+[S12]			
		Politicization		−[S3]	+ [S15]	−[S12]			
	Mediating Process	Timing of agenda setting					Not Affect [S7]		
		Number of strategic alternatives					Not Affect [S7]		
		Strategic decision-making speed					Affect [S7]		

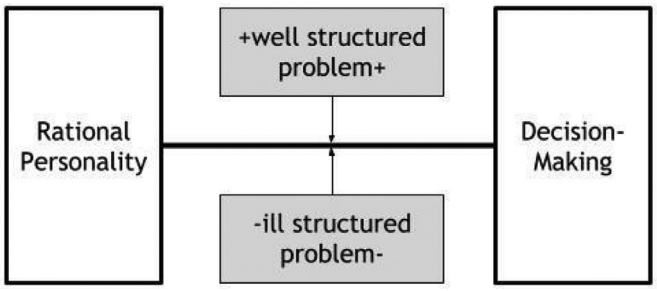

Fig. 9. Problem structure moderating factor.

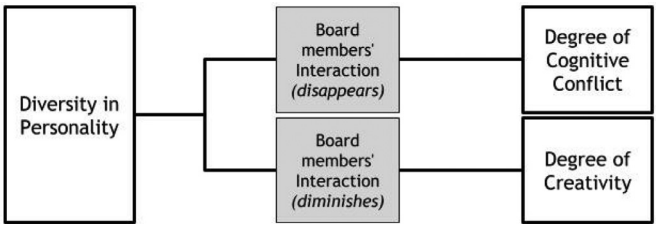

Fig. 10. Board members' interaction mediating factor.

board members were asked about the degree in which: (1) the board often reopens earlier closed issues based on suggestions from individual board members; (2) after consulting each other, board members often ask the CEO to keep the board better informed; and (3) board members prefer to consult each other rather than consult the external consultants. The output variable BMI was built as a mean of the three items (S6). Fig. 10 shows the mediating factor of BMI reported in [S6]. Note that the relationship between diversity personality and degree of cognitive conflict disappears when there is board's member interaction, and the relationship between diversity in personality and degree of creativity diminishes when there is such interaction.

The value of the variable **Similar Degree of Team Diversity** (SDTD) was calculated from the answer to a questionnaire about the experience of the team, regards to organizational background. They evaluated and classified the team experience in heterogeneous or homogeneous (S7). Fig. 11 shows the moderating factor of SDTD reported in [S7].

Considering the amount of reported moderating or mediating factors, we can conclude that few studies included these type of variable in their model. Furthermore, considering the reported variables, only problem structure is not related to group decision-making.

5. Discussion

Despite the strategy used by the authors to identify and include as many studies as possible, only 15 articles were included in this SLR. By observing the time span of the studies, it seems that the interest in the topic has increased after 2002, and during the 90's there was lack of interest in this subject, despite there are some papers published in the 80's.

Although the set of included papers discusses many decision-making aspects (see Table 10), there are still many aspects that need investigation, for example, the level of participation of the decision stakeholders in the decision-making process. If we consider all identified the personality aspects there are many personality aspects that need to be studied. For example, California Psychological Inventory has 20 different personality core scales, however, only the flexibility scale was investigated.

We conducted an aggregation of the personality aspects in order to check which was the most investigated personality aspect. We considered the association between FFM factors and the personality aspects

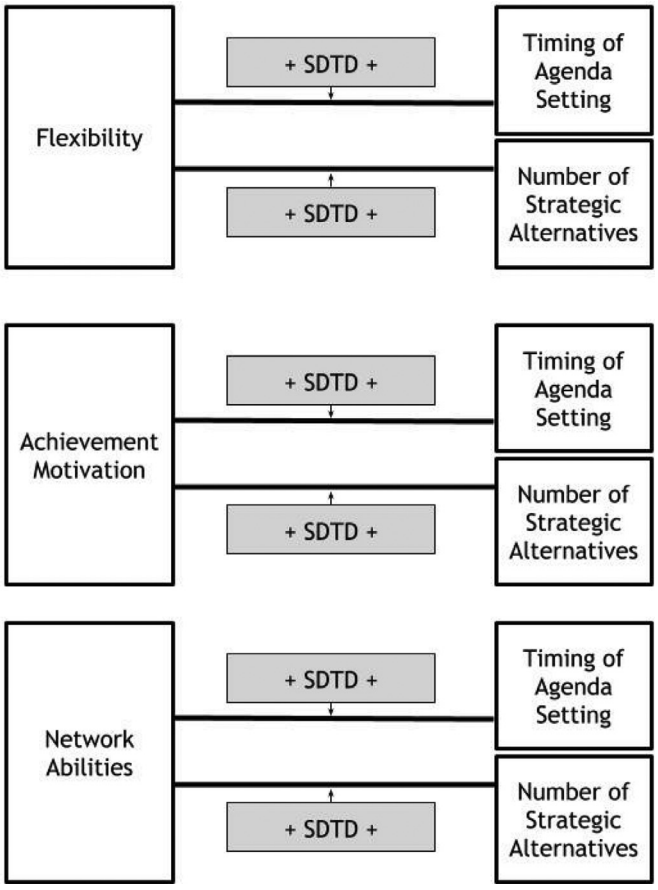

Fig. 11. Similar degree of team diversity (SDTD) moderating factor.

of our list considering [8,34]. Table 16 shows how the association was made as well the reference used to justify it.

Observe in Table 16 that some personality aspects are associated with more than one FFM factor and there are some with no reference and no association. In these cases, we excluded the personality aspect from the aggregation showed in Table 17.

It is possible to notice in Table 17 that, considering the association presented in Table 16, the most investigated FFM factor is openness and the less investigated one is Extroversion. The decision-making aspects investigated for openness are those related to the strategic decision, decision-maker, decision-making characteristics, decision style, decision-making orientation.

We can observe a wide range of decision-making aspects, however, if we consider a specific subject in decision-making even fewer articles can be included. For example, if we consider group decision making (when the decision is made for a group of people) only 5 of the 15 included articles discuss aspects related to this type of decision (S6, S7, S8, S9, and S12). The decision-making aspects discussed in these papers are: timing of agenda setting (S7), number of strategic alternatives (S7), strategic decision-making speed (S7), board members' interaction (S6), cognitive conflict (S6), decision quality (S8, S9), perceived decision effectiveness (S9), and strategical decision process characteristics (comprehensiveness/ rationality, hierarchical decentralization, lateral communication, and politicization) (S12).

Therefore, if focusing only on the decision-making and personality relationship topic, there are several gaps, as above-mentioned. This means that further research in this topic is necessary to investigate a wider range of decision-making aspects and to explore better their relationship with personality aspects.

Table 16
Personality aspects identified in this SLR and the associated FFM factor.

Instrument	Personality Aspect	Association	Ref
Myers-Briggs Type Instrument	Sensing/Intuition	O	[34]
	Thinking/Feeling	A	[34]
	Extro/Introversion	N, E	[34]
	Judging/Perceiving	C	[34]
	Sensing-thinking type	O and A	[34]
	Intuition-thinking type	O and A	[34]
	Sensing-feeling type	O and A	[34]
	Intuition-feeling type	O and A	[34]
	Analytic	–	NF
	Intuitive	–	NF
	Mixed Types (Analytic and Intuitive)	–	NF
Steers and Braunstein Instrument	Need of Achievement	C	[8]
Business-focused Inventory of Personality	Flexibility	O	[8]
	Achievement Motivation	–	NF
	Networking Abilities	A	[8]
	Action Orientation	A	[8]
Flexibility scales of the California Psychological Inventory	Flexibility	O	[8]
Rotter's locus of control instrument	Locus of Control	N	[8]
Jackson Personality Inventory + Eysenck and Eysenck Instrument	Risk Propensity	–	NF
Hyrsky and Tuunanen Instrument	Risk Attitude	E	[8]
No Mention of Personality Instrument	Personality differences	All	–
	Diversity in personality	All	–

Observations: *- Ref: Reference that justifies the association to the FFM factor. -A: Agreeableness; -Conscientiousness; -E: Extroversion; - N: Neuroticism; - O: Openness; - Many: The personality aspect is associated to many different FFM factors; - NF: It was not possible to find a reference to support the association to any FFM factor.*

Table 17
FFM factors.

Personality Traits	References	# of Rel
Openness	S7, S8, S9, S10, S14	11
Agreeableness	S5, S7, S9, S14	10
Conscientious	S9, S10, S12, S14, S15	10
Neuroticism	S2, S3, S5, S10, S14	9
Extroversion	S5, S14, S15	4

The results presented in this paper are important for researchers who are studying human factors that can influence decision-making. The results can be used, for example, to decide which personality or decision-making aspect warrants further investigation. It is also a good reference to characterize the relationship between personality on decision-making.

The results obtained from this SLR are also important for an individual or organization aiming to improve the decision-making process, for example, by helping on choosing the right people to lead an important decision.

5.1. Limitation of this review

The most common limitations in an SLR are the biases introduced during the process execution. These are also limitations related to this work.

In order to prevent **bias in general** we developed a detailed plan considering the guidelines presented by [14]. Furthermore, to prevent **selection bias,** we conducted a validation of the papers selection by two experienced researchers (second and third authors). The detailed description is presented in the beginning of Section 3 and in Appendix C.

To prevent the bias related to **poor coverage of the articles**, we selected databases considering some other literature reviews, one that investigated personality [13], and another that investigated decision-making [12], and a third one that investigated the relationship between decision-making and personality [8] (see Section 3.2.2). The string was also built considering these same literature reviews and calibrated considering the principles defined by [15]. Further, the search strategy included backward and forward snowballing rather than only electronic databases searching.

About the **data extraction and quality assessment bias**, the two experienced researchers also reviewed part of the extracted data and judge it good enough. This strategy is presented in Section 3.

However, even with all these strategies, it is possible that some studies that discusses the relationship between decision-making and personality aspect were not included in the set of studies analyzed by this SLR. The same is valid for the selection process (maybe some paper that should be included was not included in this set) and to extraction data process (maybe some mistake was made during the data extraction on included papers).

6. Conclusion

This SLR aimed to identify empirical studies that discuss the relationship between decision-making and personality, considering the context of companies that develop any kind of product or service. Since we were not able to find any study that discusses this subject in the context of software engineering, we decided to expand the scope to other knowledge areas.

We used the guidelines defined in [14] to plan and execute the literature review. We searched for papers using three different strategies:

electronic databases searching, backward and forward snowballing. The use of these different strategies helped us to expand the search scope and to retrieve as many studies as possible. The string and the selection of databases were based on three different literature review [8,12,13]. In total, considering all the three search strategies employed in this SLR, we analyzed 3847 articles, and 15 were relevant and included in the SLR. The first included paper was published in 1986 and the last one in 2016, however, there is a gap of publication (more than 10 years) between these periods.

Most of the included papers employed surveys and experiments as research methods. However, the quality of the reporting provided for the 20 papers using experiments was poor. The included papers were published in nine different journals and one conference; however, only one of them was not published in a Management field's venue.

The included papers employed eight different instruments to assess personality and studied 28 different personality aspects. In relation to decision making, they studied 30 different decision-making aspects. A total of 75 relationships were identified, mostly via quantitative methods. We also found three different variables that moderate (2 variables) or mediate (1 variable) in total, nine different relationships between some personality and decision-making aspect.

Future work related to this SLR entails conducting empirical studies to investigate the relationship between personality and decision-making in the context of software development. As previously mentioned, despite the importance of the topic, we were unable to find any study that discusses the relationship between personality and decision-making in the context of Software Engineering. We believe that such understanding can help the community to create new ways to improve decision-making by providing intervention and/or training, according to each case.

For example, this SLR results can be used to inform companies on whether the current key decision-makers present the desired personality characteristics, and use such results, if applicable, to provide them with the necessary training.

Acknowledgments

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Appendix A. Verification of overlap between data-bases - results

In order to verify the overlap between the databases selected for this SLR, we run the final string (Table 3) in all selected database. The result was exported to bib format and imported in Parsifal tool. Using this tool, we detected the duplicated articles and counted the number of each one. Table A.18 presents the results of the verification. The first column and the first row present each database with the number of returned articles. Observe the highlighted cell that indicates a complete overlap between OVID and SCOPUS.

Table A.18
Results of overlapping verification between databases.

	EBS (90)	IEE (152)	OVI (6)	SD (43)	SCO (338)	WIL (137)
ACM (74)	0	1	0	0	2	0
EBSt (90)		0	3	0	21	9
IEE (152)			0	0	20	0
OVI(6)				0	**6**	0
SD(43)					22	0
SCO(338)						5

EBS: EBSCOhost. **IEE:** IEEExplore. **OVI:** Ovid. **SD:** Science Direct. **SCO:** Scopus. **WIL:** Wiley.

Appendix B. Number of recovered articles before and after including the third Term

Table B.19 shows the number of recovered studies per database considering two strings. The first string did not include the synonyms related to the company (the context of this SLR). The first and second strings are:

Table B.19
Number of returned article per database.

Database	1st String	2nd String
ACM Digital library	453	74
EBSCOhost	2567	90
IEEE Xplore	154	154
Ovid	90	6
Science Direct	484	43
Scopus	4300	338
Wiley Online Library	726	137
Total	**8772**	**842**

- **1st String:** (personality OR extroversion OR "emotional stability" OR "locus of control" OR agreeableness OR conscientiousness OR openness OR "psychological typology" OR "psychological types" OR "temperament types") AND ("decision making" OR "decision-making" OR "decision theory" OR "decision model")
- **2nd String:** (personality OR extroversion OR "emotional stability" OR "locus of control" OR agreeableness OR conscientiousness OR openness OR "psychological typology" OR "psychological types" OR "temperament types") AND ("decision making" OR "decision-making" OR "decision theory" OR "decision model") AND (company OR enterprise OR team OR "work group" OR industry)

Appendix C. Validation of selection phase

The validation happened in two iterations, as shown on 5. During the first iteration, 76 articles (20% of the total number of retrieved paper) were selected randomly. The first author analyzed all papers and made a decision about the selection of these papers. At the same time, the papers were also distributed to the two other authors, one received 38 papers and the other one others 38 papers. They also made a decision about the inclusion of these papers and then the kappa number was calculated. Table C.20 shows the result of the validation.

The Kappa number was calculated according to the guidelines provided in [14, p. 69–71]. For the first iteration, the kappa number was 0.1099 which is **poor level of agreement**. Then the researchers discussed the disagreement and run a new iteration. The results of the second iteration are presented in Table C.20.

Table C.20
Results of the first iteration of the validation of articles' selection.

First Iteration					
		Senior Researchers			Total
		Exc	Dou	Inc	
Junior Researcher	Exc	52	10	4	**66**
	Dou	0	0	0	**0**
	Inc	5	4	1	**10**
Total		**57**	**14**	**5**	**76**
Second Iteration					
		Senior Researchers			Total
		Exc	Dou	Inc	
Junior Researcher	Exc	42	2	2	**46**
	Dou	2	3	0	**5**
	Inc	1	0	2	**3**
Total		**45**	**5**	**4**	**54**

Exc: Excluded; **Dou:** Doubt; **Inc:** Included.

Table E.21
Template of data extraction form.

Data Item		Value	RQ
Study ID		–	–
Publication Title		–	–
Authors		–	–
Study Type		Experiment, case study, survey or mixed types	–
Study	Contributions	Market, organization product, process, practices/tools/techni- ques and/or people	–
Context	Facets		
	Context Facets Description	Observe the suggestions provided in [30]	
	Subject and Sampling	Describe characteristics of the study subject for example, number of participants, response rate, type of industry	
	Data Collection	Describe how the data was collected	
	Data Analysis	Describe how the data were analyzed	
	Personality aspect and the related instrument	–	1.1
Decision-making aspect		–	1.2
Personality aspect, related decision aspect and the relationship type		–	1.3
Moderated or mediated variable and its influence on the relationship		–	1.4

For this second iteration, we chose randomly another set of articles and also a smaller number of articles. The kappa number calculates the results of this second iteration was 0.5327 which is **moderate level of agreement**. The researchers considered this number satisfactory and then the validation of the selection phase finished.

Appendix D. List of included articles

S1. Neuert J, Hoeckel CA. The Impact of Personality Traits and Problem Characteristics on Management Decision-Making Outcomes: Some Experimental Findings and Empirical Conclusions. Journal of Business and Management. 2013 Sep 1;19(3):79.

S2. Selart M. Understanding the role of locus of control in consultative decision-making: A case study. Management Decision. 2005 Mar 1;43(3):397–412.

S3. Papadakis VM. Do CEOs shape the process of making strategic decisions? Evidence from Greece. Management Decision. 2006 Mar 1;44(3):367–94.

S4. Müller R, Spang K, Ozcan S. Cultural differences in decision making in project teams. International Journal of Managing Projects in Business. 2009 Jan 23;2(1):70–93.

S5. Erjavec J, Khan NZ, Trkman P. The Impact of Personality Traits and Domain Knowledge on Decision Making a Behavioral Experiment. In:ECIS 2016 Jun 15 (pp. Research-in).

S6. Torchia M, Calabrò A, Morner M. Board of Directors'Diversity, Creativity, and Cognitive Conflict: The Role of Board Members'Interaction. International Studies of Management & Organization. 2015 Jan 2;45(1):6–24.

S7. Kauer D, Prinzessin zu Waldeck TC, Schäffer U. Effects of top management team characteristics on strategic decision making: Shifting attention to team member personalities and mediating processes. Management Decision. 2007 Jun 26;45(6):942–67.

S8. Lin HC, Rababah N. CEOâTMT exchange, TMT personality composition, and decision quality: The mediating role of TMT psychological empowerment. The Leadership Quarterly. 2014 Oct 31;25(5):943–57.

S9. Hough JR, Ogilvie DT. An empirical test of cognitive style and strategic decision outcomes. Journal of Management Studies. 2005 Mar 1;42(2):417–48.

S10. Miller D, Toulouse JM. Chief executive personality and corporate strategy and structure in small firms. Management science. 1986 Nov;32(11):1389–409.

S11. Haley UC, Stumpf SA. Cognitive trails in strategic decisionâmaking: linking theories of personalities and cognitions. Journal of Management Studies. 1989 Sep 1;26(5):477–97.

S12. Papadakis VM, Barwise P. How much do CEOs and top managers matter in strategic decision making? British Journal of Management. 2002 Mar 1;13(1):83–95.

S13. Hunt RG, Krzystofiak FJ, Meindl JR, Yousry AM. Cognitive style and decision making. Organizational behavior and human decision processes. 1989 Dec 1;44(3):436–53.

S14. Maniatis P. Investigating influence of practical supply chain constraints on decision-making of scm agents of different personality types. International Journal of Applied Business and Economic Research. 2016. No. 6, 3859–3891.

S15. Francioni B, Musso F, Cioppi M. Decision-maker characteristics and international decisions for SMEs. Management Decision. 2015 No. 16;53(10):2226–49.

Appendix E. Template of data extraction form

Table E.21 shows the template of the data extraction form.

Appendix F. Quality assessment details

Table F.22 presents the assessment for the criteria from 4 to 10 for each article included in this SLR and for the two articles excluded because of the poor-quality score. The complete description of the criteria

Table F.22
Results of quality assessment.

ID	C4	C5	C6	C7	C8	C9	C10	Score
S1	Yes	Par	Yes	Yes	No	Yes	Yes	5.5
S2	Yes	Yes	Yes	Yes	No	Yes	Yes	6.0
S3	Yes	Yes	Yes	Yes	No	Yes	Yes	6.0
S4	Yes	Yes	Par	No	No	Yes	Yes	4.5
S5	Yes	Yes	Yes	Yes	No	Yes	Yes	6.0
S6	Yes	Yes	Par	Yes	No	Yes	Yes	5.5
S7	Yes	Yes	Par	Yes	Par	Yes	Yes	6.0
S8	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7.0
S9	Yes	Yes	Yes	Yes	No	Yes	Yes	6.0
S10	Yes	Yes	Yes	Yes	No	Yes	Yes	6.0
S11	Yes	Par	Yes	Yes	No	Yes	Yes	5.5
S12	Yes	Yes	Par	Yes	No	Yes	Yes	5.5
S13	Yes	Yes	Yes	No	No	Yes	Yes	5.0
S14	Yes	Yes	Yes	Yes	No	Yes	Yes	6.0
S15	Yes	Yes	Yes	Yes	No	Yes	Yes	6.0
E1	Yes	No	Par	No	No	No	Yes	2.5
E2	Yes	No	No	Par	No	Yes	Yes	3.5
E3	Yes	Yes	Par	No	No	No	Yes	3.5

Par: The criteria was evaluated as **par**tially met.

is presented in Table 5 The result of the assessment of criteria from 1 to 3 is not presented because they are screening question used to decide if we will conduct or not the quality assessment.

The complete reference of the rejected article based on quality assessment is following presented. They are referenced in Table F.22 as E1, E2, and E3.

- **E1:** Su-li Z, Ke-fan X. Research on entrepreneurial team members' personality traits influence on group risk decision-making. In Management Science and Engineering (ICMSE), 2010 International Conference on 2010 No. 24 (pp. 937–942). IEEE.
- **E2:** Kottemann JE, Remus WE. When and how cognitive style impacts decision-making. In System Sciences, 1988. Vol. III. Decision Support and Knowledge Based Systems Track, Proceedings of the Twenty-First Annual Hawaii International Conference on 1988 Jan 1 (Vol. 3, pp. 223–231). IEEE.
- **E3:** Taylor RN, Dunnette MD. Relative contribution of decision-maker attributes to decision processes. Organizational Behavior and Human Performance. 1974 Oct 31;12(2):286-98.

Appendix G. Personality assessment instruments

The personality was established on Social Science field on 1937, with the publication of Allport's "Personality: A Psychological Interpretation", however, the concept of individual differences was discussed at least 2000 years ago, using ancient topologies of Hippocrates and Galen (sanguine, phlegmatic, melancholic and choleric) [35, chap. 1].

The personality assessment focus on determining the characteristics that compose the differences in personality [36]. The personality is measured by psychometric tests and different personality tests can also be named as taxonomies, assessment, inventories and instruments, and they are usually self-reported [37].

The personality tests can be classified as trait or type test [37]. The type tests limited the number of clearly distinctive personality type, there is no overlap between the types, uses score format and the choices are ipsative, i.e. the respondent compares one or more desirable options and chose that more most preferred. On the other hand, the trait tests describe preferences and dispositions, use the variation on strength to characterize the personality, and usually employ Likert scale.

The personality tests can be used in different areas, for example, education, human resources, and counseling. There are many different personality tests, however, it is important to examine the reliability and validity of it [38, chap. 2]. These two criteria can show how "good" is the test. The reliability is an index that expresses the reproducibility or dependability of measurement [35, chap. 1]. On the other hand, validity refers to if the test measures what it should measure [38, chap. 2]. The remaining sections will bring an overview of the personality tests identified in this SLR.

G.1. Eysenck and eysenck instrument (or three factors model)

Hans J. Eysenck, a German psychologist researcher that spent most of his life in England, developed a theory named Three Factors Model [9, chap. 13]. He believed that the personality is determined genetically and that the traits remain stable during the lifespan, with no influence of social or environmental experiences [39, p.224].

Through factor analysis, Eysenck found three main personality types, that he called super traits [38, chap. 8]. The three main factors are extroversion x introversion, neuroticism x emotional stability, and psychoticism x impulsive control. Table G.23. shows some adjectives for each of the three dimensions proposed by Eysenck.

The Eysenck Personality Instrument (EPI) was developed in 1964 and in 1982 Eysenck run a cross-cultural study to assess the validity of the instrument in different cultures [40, chap. 4]. The self-reported questionnaire is composed of yes/no questions, including some lie scales to verify tendencies to fake.

Table G.23
Dimensions and characterization of Three Factors Instrument (source: [39, p.225]).

Extroversion	Neuroticism	Psychoticism
Sociable, lively, active, assertive, sensation seeking, carefree, dominant, venturesome	Anxious, depressed, guilt feelings, low self-esteem, tense, irrational, shy, moody	Aggressive, cold, egocentric, impersonal, impulsive, antisocial, creative, though-minded

G.2. Five factors model (FFM)

Five Factors Model (FFM) or Big Five is a model that integrates all personality traits in five main dimensions. In 1949 Fiske conducted a study using Cattellâs 16 factors of personality and found only 5 main factors to explain personality variability. After this, there were some studies on 60's but during 80's and 90's many works confirmed these five factors of human personality [40, chap. 4], these were named basic dimensions of personality.

According to FFM theory, the traits are determined biologically and generates characteristics adaptation which is influenced by external factors like culture. These characteristics determine the human behavior [10, chap. 6]. Fig. G.12 illustrates the components of personality traits and the relationship between them.

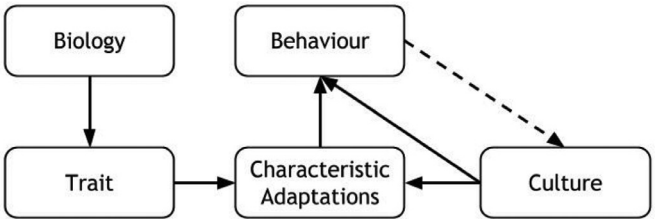

Fig. G.12. Components of personality and relationship between them [10, p. 159].

The five factors are neuroticism, extroversion, openness, agreeableness, and conscientiousness. Table G.24 shows the factors and the description, using some adjectives, for each of the five factors.

Table G.24
Big Five Personality Factors [39, p.229].

Factor	Description
Neuroticism	Worried, insecure, nervous, highly strung
Extroversion	Sociable, talkative, fun-loving, affectionate
Openness	Original, independent, creative, daring
Agreeableness	Good-natured, softhearted, trusting, courteous
Conscientiousness	Careful, reliable, hardworking, organized

There are many questionnaires to assess the personality considering the five factors. The NEO-PI-R (Revised NEO Personality Inventory) is one of them. It was created by Costa and McCrae in 1992, with 240 self-reported questions, 48 for each factor, the answers have five points from strongly agree to strongly disagree [10, chap. 6].

G.3. Manifest needs questionnaire (MNQ)

Steers and Braunstein developed, based on the Theory of Murray, a questionnaire to measure the need for achievement, affiliation, autonomy, and dominance. The Theory of Murray is based on motivational construct and has 20 psychogenic needs [35, p.9].

The MNQ goal was developed to have an instrument that could be used in work settings, spending minimal time and with good validity and reliability. The questionnaire is composed of 20 statements about things that people do or try to do during the execution of job activities [41]. They used 7-point Likert Scale: always, almost, usually, sometimes, seldom, almost never and never (Jackson, 1994). This is an example of a statement: "I do my best when my job assignments are fairly difficult" [41].

G.4. Rotter'S locus of control instrument

Locus of Control (LOC) theory was developed by Julian Rotter, he was born in New York and study the social learning approach to personality (Schultz and Schultz, 2016, chap. 14). LOC is related to the belief if the things that happen with someone is caused by this one (internal LOC) or it is just because of good or bad luck (external LOC) [9, chap. 16]. The LOC scale varies from strongly internal to strongly external.

People with internal LOC are usually happier and hard worker, on the other hand, people with external LOC usually give up quickly, understand better their limits and tend to set reasonable goals [38, chap. 14].

The Internal-External (I-E) Rotter's LOC Scale has 23 forced-choices alternatives, that describe beliefs. Table G.25 shows a sample of Rotter's I-E Scale.

Table G.25
Sample of I-E Rotter's Scale [39, p.359].

1. a. Many of the unhappy things in people's lives are partly due to bad luck.
b. People's misfortunes result from the mistakes they make.
2. a. One of the major reasons why we have wars is because people don't take enough interest in politics.
b. There will always be wars, no matter how hard people try to prevent them.
3. a. In the long run people get the respect they deserve in this world.
b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he or she tries.
4. a. The idea that teachers are unfair to students is nonsense.
b. Most students don't realize the extent to which their grades are influenced by accidental happenings.
5. a. Without the right breaks one cannot be an effective leader.
b. Capable people who fail to become leaders have not taken advantage of their opportunities.

G.5. Myers-Briggs type indicator (MBTI)

The MBTI was created by Katharine Cook Briggs and Isabel Briggs Myers in 1920's [39, chap. 3]. Based on Jung's personality theory, it is a paper-pencil self-reported inventory, composed of 94 forced-choice items [42].

The instrument defines 16 different personality types, considering the four dichotomies defined in Jung's theory: introversion/extroversion, sensation/intuition, thinking/feeling, judging/perceiving. The idea is to sort the respondents into categories, into preferred poles [43, chap. 1]. Fig. G.13. shows the four dichotomies and a brief description of each one.

Functions or Process of Perception					Atitudes or Orientation of Energy
	Sensing (S):	**Intuition (N)**	**Extraversion (E):**	**Introversion (I)**	
	Focusing mainly on what can be perceived by the five senses.	Focusing mainly on perceiving patterns and interrelationships.	Directing energy mainly toward the outer world of people and objects.	Directing energy mainly toward the inner world of experiences and ideas.	
	CONCRETE REALISTIC PRACTICAL EXPERIMENTAL TRADITIONAL	ABSTRACT IMAGINATIVE CONCEPTUAL THEORETICAL ORIGINAL	INITIATING EXPRESSIVE GREGARIOUS ACTIVE ENTHUSIASTIC	RECEIVING CONTAINED INTIMATE REFLECTIVE QUIET	
Functions or Process of Judgement					**Attitudes or Orientation to Outer World**
	Thinking (T):	**Feeling (F)**	**Judging (J):**	**Perceiving (P)**	
	Basing conclusions on logical analysis with a focus on objectivity and detachment.	Basing conclusions on personal or social values with a focus on understanding and harmony.	Preferring the decisiveness and closure that results from dealing with the outer world using one of the judging processes (T or F).	Preferring the flexibility and spontaneity that results from dealing with the outer world using one of the perceiving processes (T or F).	
	LOGICAL REASONABLE QUESTIONING CRITICAL TOUGH	EMPATHETIC COMPASSIONATE ACCOMMODATING ACCEPTING TENDER	SYSTEMATIC PLANFUL EARLY STARTING SCHEDULED METHODICAL	CASUAL OPEN-ENDED PRESSURE PROMPTED SPONTANEOUS EMERGENT	

Fig. G.13. MBTI dichotomies and characterization of each one (created by the authors, based on the content presented in [40, chap. 3].

G.6. Business-focused inventory of personality

This instrument was developed in Germany, but it has a translation in many European languages. It was specially developed to the workplace environment. Business-focused Inventory of Personality (BIP) questionnaire measure 14 characteristics related to human personality and relate to four broad areas of behavior at work. However, it is important to highlight that it does not represent all human being personality [44]. Fig. G.14 presents the 14 characteristics and the four areas that each one.

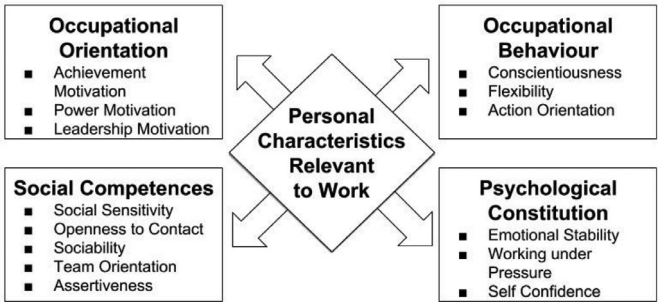

Fig. G.14. Characteristics of BIP and its four areas [44].

G.7. Jackson personality inventory

The first publication of the Jackson Personality Inventory (JPI) was in 1976, and the reviewed version was published in 1994. JPI contains 300 true-false statements distributed in 15 scales. Usually, it is necessary from 35 to 45 min to complete the test [45].

The instrument is suitable to use in schools, colleges, and universities to help on career and vocational test; work settings to help on job matching. It can be used in the normal population, in psychological disturbed or deviant individuals [45]. Table G.26. shows the clusters, the 15 scales and the adjectives for those with a high score in the related scale.

G.8. Hyrsky and tuunanen instrument

The study presented in [46] compared the entrepreneurial behavior differences between entrepreneurs from the USA and from Finland. They measured two specific personality traits: innovativeness and risk-taking. A sample of the questionnaire is shown in Table G.27.

The personality test employed in this instrument was adapted from Jackson Personality Instrument. They adapted the instrument using 40 questions, forced-choice type, 20 to assess innovativeness and 20 to assess risk-taking attitudes. The risk-taking attitudes questions are directed to four facets: monetary, physical, social and ethical.

G.9. California psychological inventory

The California Psychological Inventory (CPI) was developed by Gough in 1957. This first version contained 15 scales and, in 1957 another version was published with 18 scales. Finally, in 1987, more two scales were included. Nowadays, the CPI has 20 core scales classified in four different domains: (1) interpersonal style and orientation, (2) normative orientation and values, (3) cognitive and intellectual function, and (4) role and personal style [47, chap. 9]. The domain (1) indicates traits related to social equilibrium, the domain (2) is related to mental health, the domain (3) presents scales related to independence, and domain (4) is related to compliance to social norms. These domains assist on interpretation and report of the CPI results [47, chap. 9].

The test is self-administered, and paper-and-pencil based, usually used to evaluate individuals with the ages from 12 to 70 years old. It is composed of 434 true-false statements. Fig. G.15. presents the four domains, the sales and some adjectives commonly used to characterize someone with a high score on the scale.

Table G.26
Clusters, scales, and adjectives of JPI (table adapted from Table 1.1 presented on [45]).

Cluster	Scale	Adjectives for High Score
Analytical	Complexity	Complex, contemplative, clever, discerning, intellectual, thoughtful, analytical
	Breadth of Interest	Curious, interested, inquiring, involved, inquisitive, seeking, exploring
	Innovation	Ingenious, original, innovative, productive, imaginative
	Tolerance	Broad-minded, open-minded, unprejudiced, receptive, judicious, impartial, dispassionate, lenient, indulgent
Emotional	Empathy	Emotional, tender, kind, affectionate, demonstrative, warm-hearted, sympathetic, compassionate
	Anxiety	Worried, tense, nervous, preoccupied, anxious, edgy, distressed, agitated, fearful
	Cooperativeness	Compliant, agreeing, acquiescent, adapting, accommodating, cooperative, concurring, emulating
Extroverted	Sociability	Sociable, friendly, gregarious, outgoing, joiner, convivial, companionable, fun-loving, extrovert, congenial, cordial, good-natured
	Social Confidence	Self-assured, composed, egotistical, self-possessed, poised, self-sufficient
	Energy Level	Lively, vigorous, active, persevering, industrious, tireless, dynamic, enthusiastic, eager
Opportunistic	Social Astuteness	Shrewd, sophisticated, tactful, crafty, influential, subtle, persuasive, discreet, worldly
	Risk Taking	Reckless, bold, impetuous, intrepid, enterprising, incautious, venturesome, daring, rash
Dependable	Organization	Orderly, disciplined, planful, tidy, consistent, methodical, precise, neat, meticulous, systematic
	Traditional Values	Moralistic, conventional, strict, prim, devout, prudish, puritanical, righteous, rigid
	Responsibility	Responsible, honest, ethical, incorruptible, scrupulous, dependable, conscientious, reliable, stable, straightforward

Table G.27
Sample of questionnaire [46].

Innovation Scale		
If you agree with a statement or think it describes you, circle T. If you disagree with a statement or decide it does not describe you, circle F.		
T	F	People often ask me for help in creative activities
T	F	I seldom bother to think of original ways of doing a task
T	F	I often try to invent new uses for everyday objects
Risk Taking Scale		
If you agree with a statement or think it describes you, circle TRUE. If you disagree with a statement or decide it does not describe you, circle FALSE.		
T	F	If I invested money in stocks, it would probably only be in safe stocks from large, well-known companies.
T	F	If the possible reward was very high, I would not hesitate putting my money into a new business that could fail.
T	F	I consider security an important element in every aspect of my life.

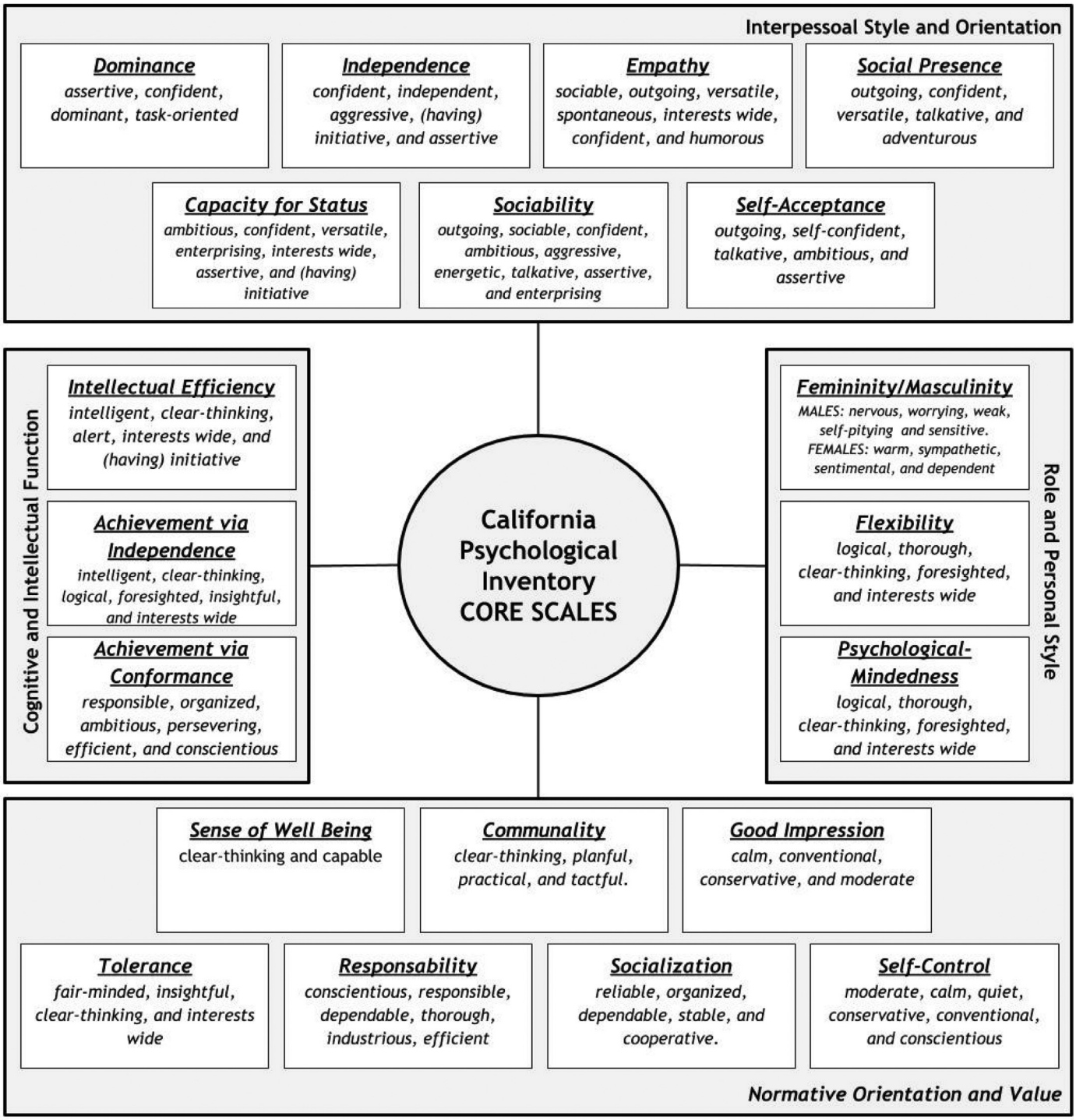

Fig. G.15. The domains, scales, and adjectives of CPI (figure created by the author, based on the content presented by [47, chap. 9].

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