SYSTEMATIC LITERATURE REVIEWS: AN INTRODUCTION

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Systematic literature reviews (SRs) are a way of synthesising scientific evidence to answer a particular research question in a way that is transparent and reproducible, while seeking to include all published evidence on the topic and appraising the quality of this evidence. SRs have become a major methodology in disciplines such as public policy research and health sciences. Some have advocated that design research should adopt the method. However, little guidance is available. This paper provides an overview of the SR method, based on the literature in health sciences. Then, the rationale for SRs in design research is explored, and four recent examples of SRs in design research are analysed to illustrate current practice. Foreseen challenges in taking forward the SR method in design research are highlighted, and directions for developing a SR method for design research are proposed. It is concluded that SRs hold potential for design research and could help us in addressing some important issues, but work is needed to define what review methods are appropriate for each type of research question in design research, and to adapt guidance to our own needs and specificities.

1 INTRODUCTION

Literature reviews and evidence syntheses are important research products that help us advance science incrementally, by building on previous results. In the past two decades, health sciences have been developing a distinctive approach to this process: the systematic literature reviews (SR). Compared to traditional literature overviews, which often leave a lot to the expertise of the authors, SRs treat the literature review process like a scientific process, and apply concepts of empirical research in order to make the review process more transparent and replicable and to reduce the possibility of bias. SRs have become a key methodology in the health sciences, which have developed a specific infrastructure to carry these reviews and keep refining the method to address new research questions.

Some authors in the 'design science' movement in management research propose that design scientists should use this approach to develop design propositions based on systematic reviews of empirical evidence (Tranfield et al., 2003, van Aken and Romme, 2009). Other authors have lamented the limited uptake of the SR method in design research, as it hinders our capacity to make progress in research by accumulating and synthesising our results (Cash, 2018). However, no guidance exists on how to perform these reviews, and the method is not part of the traditional design research toolbox.

This paper is intended as a starting point for design researchers interested in the SR methodology, providing a methodological overview, highlighting sources of information, and exploring the adaptability of the concepts to design research. Although SRs are used in a variety of disciplines (e.g. education, public policy, crime and justice), this article builds on the literature on SRs in health sciences. It has two objectives:

- Define SRs and give an overview of the methodology as used in health sciences, with its processes, its strengths and the challenges it poses. This aspect is treated in Section 2.
- Explore the rationale for doing SRs in design research and identify challenges that can be expected when doing SRs in this discipline. This is developed in Section 3.

2 SYSTEMATIC REVIEWS IN HEALTH SCIENCES

2.1 Historical background and rationale for SRs in health sciences

Although principles and elements of modern SRs can be found in studies dating back to the 18th and 19th century (Chalmers et al., 2002), SRs really took their contemporary form and importance in health sciences in the late 20th century. In the 60's to 80's, a series of studies showed wide variations in practice between physicians, with practices discarded by research still being performed, and inappropriate care delivered as a result, e.g. (Chassin et al., 1987). This gave birth to the movement of 'evidence-based medicine', which aimed to support clinical practice with the results of the best available scientific research, and to reduce reliance on intuition and un-scientific guidelines (Sackett et al., 1996). Using the best evidence available is now considered a moral obligation in medical practice (Borry et al., 2006).

However, informing practice with scientific evidence required methods to review and synthesise the existing knowledge about specific questions of practical relevance to medical professionals. The rate at which science progresses is so rapid that no practitioner could keep up with the scientific literature, even on very specific topics. Therefore, the evidence-based medicine movement needed procedures to synthesise knowledge on medical practice, and to identify clearly areas where research was lacking to support practice. At that time, health sciences mainly relied on 'narrative reviews' to synthesise research. These reviews provided a general overview of a topic, and relied on the expertise of the author, without attempting to synthesise all relevant published evidence or describing how the papers included had been identified and synthesised. The issue with such reviews is that they leave it up to the expert author to decide what should be included or not, and do not allow readers to track and assess these decisions. These reviews also often do not explicitly assess the quality of the included studies. This creates the potential for bias in the results of the review.

Narrative reviews traditionally constituted the majority of published reviews in medical journals, including the most prestigious ones. In 1987, a review of 50 literature reviews in major medical journals found only one with clearly specified methods for identifying, selecting, and validating included information (Mulrow, 1987). A similar study in 1999 reviewed 158 review papers, and showed that 'less than a quarter of the articles described how evidence was identified, evaluated, or integrated; 34% addressed a focused clinical question; and 39% identified gaps in existing knowledge' (McAlister et al., 1999). To overcome these issues, and the many potential sources of bias in identifying, selecting, synthesising and reporting primary studies, researchers proposed to treat the review process as a scientific process in itself, which developed into the SR process (Dixon-Woods, 2010).

2.2 Definition, principles and procedures for systematic reviews

SRs are a way of synthesising scientific evidence to answer a particular research question in a way that is transparent and reproducible, while seeking to include all published evidence on the topic and appraising the quality of this evidence. The main objective of the SR approach is to reduce the risk for bias and to increase transparency at every stage of the review process by relying on explicit, systematic methods to reduce bias in the selection and inclusion of studies, to appraise the quality of the included studies, and to summarise them objectively (Liberati et al., 2009, Petticrew, 2001).

SRs can be carried on a variety of topics in the health sciences. The main ones can be identified by looking at the type of reviews produced by the Cochrane collaboration (https://www.cochranelibrary.com/about/about-cochrane-reviews, see (Munn et al., 2018) for a complementary typology). For instance, *intervention reviews* assess the benefits and harms of interventions used in healthcare and health policy, while *methodology reviews* address issues relevant to how systematic reviews and clinical trials are conducted and reported and *qualitative reviews* synthesize qualitative evidence to address questions on aspects of interventions other than effectiveness.

The standard process for developing, conducting and reporting a SR in these topics in clinical disciplines is as follows (Egger et al., 2008):

1. **Formulate review question**: why is this review necessary? What question needs answering?

2. **Define inclusion and exclusion criteria**: set criteria for the topic, the methods, the study designs, and the methodological quality of studies to be reviewed.
3. **Locate studies**: develop a search strategy aimed at covering the broadest possible range of sources relevant to your research question. Sources include databases like Scopus or Web of Science, but also study registers, academic repositories for theses, reference lists and citation lists of included articles, books, communications with experts, and possibly searching the 'grey literature'.
4. **Select studies**: assess the studies identified by your search strategy to decide if they meet the inclusion criteria. This step is usually performed in two stages: a first stage where reviewers screen titles and abstracts (often thousands of them), and a second stage where they screen the full texts that were not excluded in the first stage. Usually, at least two reviewers carry this task, and a procedure is set in case they disagree on a study (often a third reviewer stepping in). A reason is identified for all studies excluded.
5. **Assess study quality**: use a pre-defined method for assessing the quality of included studies. Various tools exist for this stage (Crowe and Sheppard, 2011). Again, usually two reviewers assess each article in parallel, and their level of agreement is monitored.
6. **Extract data**: use a pre-defined form to extract the data of interest from each included study. Again, usually performed by two reviewers in parallel.
7. **Analyse and present results**: use a pre-defined method to analyse the data and synthesise the information from included studies. Perform sensitivity analysis if possible. If the results of all studies are pooled together in a quantitative analysis, this is called *meta-analysis*.
8. **Interpret results**: consider the limitations of the review, the strength of the evidence it surfaced, how the research question is answered, and what areas for future research have emerged.

To ensure that the methods for steps 1 to 7 are included in the protocols of SRs, a reporting guideline was established to support more standardised SR protocol writing (Moher et al., 2015). Another reporting guideline specifies what elements should appear in published reports of systematic reviews (Moher et al., 2009). An emblematic element of these guidelines is the PRISMA chart, which shows how many studies were assessed, from which sources, how many were excluded and for which reasons, and how many were finally included (Figure 1).

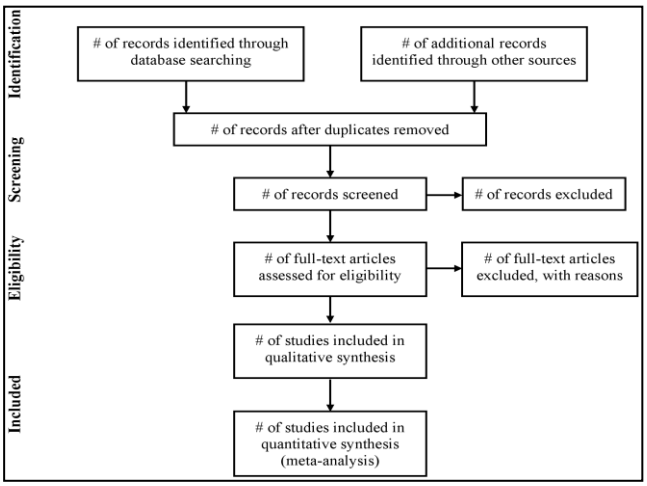

Figure 1. PRISMA chart for reporting systematic reviews (Moher et al., 2009)

Following this approach, the review process is more transparent and replicable, and it allows the recommendations that come out of the review to be traced back to primary studies. Methods are explicit, therefore open to critic, and allow for assessing potential biases at every stage of the review. Table 1 shows how this is in contrast with the process followed for traditional narrative overviews.

Table 1. Comparison of overviews and systematic reviews in medicine. Adapted from (Petticrew, 2001, Cook et al., 1997)

	Narrative overview	**Systematic review**
Review question	Often broad, no specified hypothesis or focused question	Focused question or hypothesis to be tested

Search for primary studies	Usually unspecified, potential for publication bias	Explicit search strategy, attempting to locate all published and unpublished evidence
Selection of primary studies	Usually unspecified, potential for selection bias through 'cherry-picking' articles	Explicit inclusion and exclusion criteria to limit selection bias
Appraisal of primary studies	Usually unspecified, potential for including poor-quality studies	Explicit methods to assess study quality
Synthesis	Qualitative summary	Qualitative synthesis or meta-analysis of quantitative studies using explicit methods, accounting for the quality of included studies

2.3 Success and challenges for systematic reviews in health sciences

Supported by a range of dedicated centres and collaborations,[1] the systematic review has become an important method in health sciences. SRs typically sit at the top of the 'hierarchy of evidence' in medicine (Murad et al., 2016), meaning that the method is regarded as generating the most compelling form of scientific knowledge available on a specific research question. As a result, the number of systematic reviews is increasing exponentially (Figure 1, see also (Bastian et al., 2010)).

However, there are also methodological and practical challenges to systematic reviews. First, **the initial search for relevant articles can be very long and difficult**. The precision of systematic search strategies is generally low. Reviews of published SRs have found that only around 2% of the abstracts screened for the review are ultimately included (Bramer et al., 2016). It can also be challenging to build a comprehensive search strategy in complex areas which lack the structured taxonomy that exists for drugs and pathologies, such as organisational issues (Greenhalgh and Peacock, 2005).

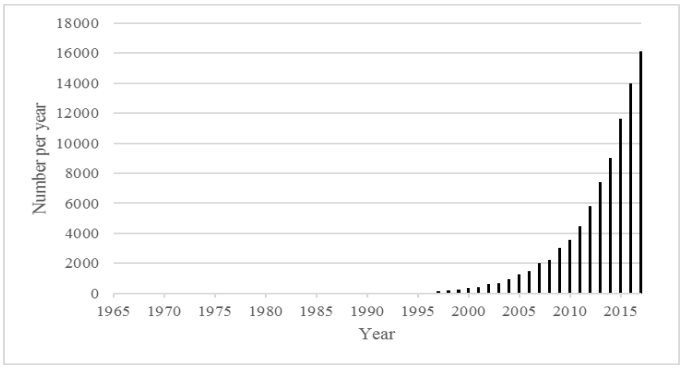

Figure 2. Search for "systematic review" in titles on the Web of Science on 15 Sep 2018.*

When building their search strategy, reviewers should try to identify all the knowledge available to answer their research question. However, **studies with negative results are less published** (Fanelli, 2012), which can give a distorted image of what is really known about a topic (Every-Palmer and Howick, 2014). To tackle this issue, some funding agencies require that the protocols for all studies be made available online through dedicated registries. This way, reviewers can contact the authors of all registered studies, even if the results have not been published.

Challenges also arise when reviews cover both qualitative and quantitative studies. The criteria for quality appraisal of qualitative studies are very different from those used for quantitative studies. Synthesising qualitative and quantitative results is also difficult, although methods have been proposed (Dixon-Woods et al., 2005).

[1] For instance, the Cochrane collaboration (https://www.cochranelibrary.com/about/about-cochrane-reviews), the Joanna Briggs Institute (http://joannabriggs.org/) or the EPPI centre (https://eppi.ioe.ac.uk/) provide methodological guidance, training and tools to support systematic reviews.

Once they have been published, **a major issue with SR is their maintenance**. Indeed, research continues to be published after the search strategy has been completed, and the results of many SRs become quickly outdated by new publications (Shojania et al., 2007).

Finally, despite all the effort put into them, **SRs are often inconclusive** (Petticrew, 2003): they show no clear answer to the question asked, and often map uncertainty rather than dissipate it. This is an important contribution in itself, as it helps orientate future research efforts, but can also be disappointing, especially to policy-makers who hope to use the results to justify decisions.

3 DOING SYSTEMATIC REVIEWS IN DESIGN RESEARCH

The overview of SRs in health sciences has shown how they have become a major consideration in the field. However, this alone would not be enough to justify their adoption in design research. Three broad reasons can be put forward to undertake SRs in design research.

First, SRs provide a structured method to help us answer important questions. The first and obvious benefit of SRs is in leveraging the strengths of the method to tackle important design research questions. For instance, there is often a lack of evidence that design methods improve design performance (Blessing and Chakrabarti, 2009). SRs can help identify and synthesise case studies, summarise all the hypotheses explored and the conclusions reached, and identify blind spots in this exploration. Another example of area of interest is the prevalence and causality of specific problems encountered by designers. On these problems, providing an explicit method for reviews can only reinforce the strength of the findings. This is especially true for *aggregative* reviews that aim at identifying all evidence on a phenomenon and testing hypotheses (e.g. *Does method X improve indicator Y in situation Z?*), which differ from *configurative* reviews that aim at identifying emergent concepts and generating new theory (e.g. *What meaning do designers attribute to X?* or *How do designers do Y?*), and for which other methods than the traditional SR have been developed (Gough et al., 2012).

Second, SRs can help us better understand and monitor research practices in our community. By assessing the use of research methods on certain topics, and using explicit frameworks to assess the quality of included studies, SRs provide a way to monitor our research activity. When and how often do design researchers use interviews, experiments, or simulation to tackle certain types of issues? How do they do it? SRs can provide important insights on the methodological quality of research, and can be used to monitor research trends (Kitchenham et al., 2009).

Third, SRs could help us bridge disciplinary boundaries and reach beyond our research community. Design as an empirical phenomenon is of interest to multiple research communities, who co-exist without always acknowledging each other (McMahon, 2012). As noted by Cash (2018), research on design has also recently been flourishing outside of the 'traditional' design societies and departments, with scholars in psychology, management and other disciplines exploring our research topics. A good SR would include the research products of all these disciplines, whereas traditional literature overviews could focus on certain 'islands' of research known to the authors (a phenomenon sometimes referred to as 'reviewer selection bias'). SRs can be an integrative device in this context.

3.1 Current practice: four examples of SRs in design research

Not many papers in the design research literature have claimed the 'systematic research' or 'meta-analysis' label so far. Reviewing them all is beyond the scope of this paper. Instead, we review four purposefully selected SRs that illustrate a broad range of practice (Bonvoisin et al., 2016, Cash, 2018, Sio et al., 2015, Hay et al., 2017). These four papers' characteristics are summarised in Table 2.

This sample shows an interesting range of approaches, from a fully quantitative meta-analysis (Sio et al., 2015) to a more critical synthesis of design publications discussing theory (Cash, 2018). Questions vary from very focused (Sio et al.: 'find out the overall impact of examples on design processes and more importantly identify the factors that can moderate the magnitude of the exemplar effects') to broader (Cash: 'how design research might be steered towards greater rigour, relevance and impact.').

The Cochrane method handbook and the PRISMA statement, epitomes of the traditional SR process in health sciences, seem influential as they are cited by three of the four papers. The most consistently reported stage is the location of studies, where all papers clearly explain which databases were searched and the keywords used. Eligibility criteria are also detailed. The number of sources searched varies, from multiple databases, as generally advised for SRs, to one database, or even a set of selected journals.

However, there is inconsistency on how other stages are performed or reported. In one paper (Sio et al., 2015), the number of articles that were searched and assessed for inclusion in the review is not reported, whereas this is an important point in SRs, as it illustrates the breadth of the literature that was searched. The summary statistics on included studies also vary (e.g. sources, types of methods). The quality appraisal of individual studies is inconsistent, and none of the four papers uses a known tool to assess the quality of included studies. The risk of bias in the results is only partially addressed, with no study discussing both the risk of selection bias (e.g. due to searching a small number of databases) and the risk of publication bias (due to positive studies being more published than negative ones).

In one of the papers, Hay et al. describe precisely how they recovered papers through explicitly defined search strings in a list of explicitly identified databases. However, they acknowledge (p25) that they had also identified other papers in 'hand searches', but did not include them in their SR as they were not covered by their structured search. This illustrates a common challenge in SRs: how replicable should the process be? If the emphasis is on replicability, then intuitive hand-searches are a problem. In this case, the authors have chosen to exclude papers that they knew could contribute, but which their search string did not capture. Yet, the higher objective of SRs is to cover all relevant literature. Intuitive hand-searches can be a useful complement to searches, and can even provide the bulk of the final SR if the topic is less structured (Greenhalgh and Peacock, 2005).

In some cases, variations from the traditional SR format seem perfectly justified. For instance, as Cash focuses on design research as a community, it is appropriate to review only the main journals of this community, although the final list may be debated. However, other points should be more consistently reported, e.g. on the screening process (single or double screening?) or on quality appraisal (how good were the studies included?), so that the research community can better monitor how different types of research methods are used.

Table 2. Characteristics of the four reviewed SRs.
B: Bonvoisin et al., 2016; C: Cash 2018; H: Hay et al., 2017; S: Sio et al., 2015.

Methodological reference for the SR method	B: Cochrane method handbook C: Cochrane method handbook and 'critical approach' H: PRISMA statement S: none stated
Research type	B, C, H: mixed aggregative and configurative; S: aggregative
Research question	B, C, H, S: explicit
Locating studies	B: one database (ScienceDirect) C: six selected journals H, S: multiple generalist (Science Direct, Web of Science) and specialised databases (e.g. PsycINFO and PubMed)
Number of articles screened	B: 560, C: 1242, H: 4996, S: unknown
Number of articles included	B: 163, C: unclear (possibly 1242), H: 47, S: 16
Eligibility criteria	B, H, S: explicit; C: described but difficult to replicate
Quality appraisal of individual studies	B: elements of quality appraisal on some of the results of the included papers C: assessment of connection with theory H, S: not reported
Assessment of risk of bias in the results of the SR	B, C, H: discussed qualitatively S: statistical analysis to assess the impact of publication bias
Approach to synthesis	B, C, H: qualitative synthesis; S: quantitative meta-analysis

3.2 Challenges to doing SRs in design research

Reading and analysing these four articles suggests challenges for conducting SRs in design research, some mentioned directly by the authors, others identified when analysing the four papers.

First, when locating studies, design research lacks the taxonomy used to describe drugs, medical interventions and diseases that reviewers can build upon in health sciences. This makes it difficult to identify all the literature on a given question in design research, simply because different authors call the same thing different names. The issue is also more fundamental, as the field sometimes struggles to agree on shared definitions of some key elements, such as design methods (Gericke et al., 2017). The lack of structured abstracts and the ambiguity in titles in design research complicates the abstract screening process (Hay et al., 2017). All these elements taken together make it difficult to build search strategies (Hay et al., 2017). This long and difficult process is supported by professional librarians in medical reviews (Rethlefsen et al., 2015). Design researchers could seek similar support. Design research also does not have registers of ongoing studies, which makes it difficult to know about studies that have been carried but not published. This is an important issue when publication bias is likely to affect the result of a SR. Searching through conference abstracts and repositories of doctoral and master theses can solve part of the issue.

Second, when appraising studies, design researchers have no reporting guidelines. Therefore, studies can be quite heterogeneous in how they report on similar topics, e.g. in studies based on interviews (Eckert and Summers, 2013), potentially leaving reviewers with missing data when comparing studies. To tackle this issue and reduce inconsistency in the reporting of primary studies, researchers in health sciences have developed guidelines that define what authors should include in their articles. The EQUATOR network (Enhancing the QUAlity and Transparency Of health Research, http://www.equator-network.org/) stored 405 such reporting guidelines on 15 September 2018.

Third, synthesising results can also be difficult due to methodological diversity. Again, this reflects a lack of agreement in the field on how to carry certain key processes, such as the evaluation of design methods (Frey and Dym, 2006, Seepersad et al., 2006).

Finally, the general SR process is long and requires hard work (Hay et al., 2017). Screening thousands of abstracts is a long and tedious task. SRs would need to be recognised as a legitimate research product in their town right to encourage people to do undertake such reviews (Chalmers et al., 2002).

3.3 Towards developing a SR methodology for design research

The examples published so far, including the four articles discussed above, show both the feasibility and the challenges of the SR approach in design research. To develop SRs as a method in design research, a starting point is to remember the guiding principles of SRs: a clear, explicit protocol, aimed at synthesising knowledge on a focused question, by reviewing evidence as comprehensively as possible, and systematically assessing the potential for bias. To that end, a first step is to be more explicit in the reporting of how reviews are conducted:

- Explain clearly what literature was searched and how (see, for instance, (Saidani et al., 2019) for an example of how this can be done simply). Specify search strategies and sources.
- Define explicit inclusion criteria that state what literature was deemed relevant for the review (based on topic, methods, source, language…).
- Consider using checklists like the PRISMA guidelines (Liberati et al., 2009, Moher et al., 2009) (or new ones developed specifically for design research) when designing and reporting reviews.

Beyond these first simple principles, the issue remains that design research tackles a very heterogeneous mix of topics, described by a very informal taxonomy of keywords, studied using a whole range of qualitative and quantitative studies and underpinned by radically different methodological approaches to research. In these cases, adhering strictly to rigid methods to maintain an image of methodological purity could lead to disappointing, and ultimately biased, results. However, health researchers have the same problem when they look at complex interventions and problems in health sciences (Shepperd et

al., 2009). Therefore, methodological variants have been developed for research questions that cannot be tackled by the traditional SR method, while retaining the core principle of transparency and explicit methods. Examples include framework synthesis, critical interpretive synthesis, meta-ethnography or realist synthesis (Gough et al., 2012, Dixon-Woods, 2010). Design research could explore the potential of these other forms of SRs by:

- Establishing a typology of research questions and objectives in literature reviews in design research. Existing typologies of design research may constitute a starting point, e.g. (Horváth, 2004, Cantamessa, 2003).
- Mapping this typology of research questions and objectives onto associated methods for literature reviews. Existing typologies of review methods may be used for this, e.g. (Gough et al., 2012, Grant and Booth, 2009).

The resulting framework would provide authors of reviews with guidelines on what method is adequate for their questions and objectives.

4 CONCLUSION

In this article, the origins and practice of SR in health sciences have been reviewed, and the strengths and challenges of this method have been identified. Then, current practice in design research was explored, and challenges for carrying SRs more broadly were anticipated.

Based on these analyses, it can be argued that if used properly, SRs could be valuable for design research. With publication rates increasing every year (Jinha, 2010), design researchers need methods to make sense of the literature and identify where contributions are needed, especially in a dispersed field like ours. This is a strength of SRs. SRs can also be a way of connecting with other communities looking at design, by reducing inclusion bias in literature reviews.

The effort involved in a SR is high. However, if design researchers believe that design is important, and if their role is to understand and improve its practice, then we have a responsibility to be rigorous, comprehensive and accurate in our diagnostics and recommendations. As researchers, we should also avoid unnecessary research duplication, and steer our research efforts where research is most needed. SRs alone cannot achieve these goals, but they can help.

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