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Critically Appraised Topic (CAT): Building a Library of Validated Practices.

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EDITORIAL NOTE

In this article, Moghadam, Yates & Baskerville introduce a new *EMR* genre, the *Topic Paper*, by discussing the methodology behind Critically Appraised Topics (CATs) and providing two examples of this highly focused, practice-oriented, version of a systematic literature review. *Topic Papers* are a kind of engaged literature review; such reviews provide research-based evidence that validate (or invalidate) practical answers to practical questions. Using the research literature, *Topic Papers* help distinguish practices confirmed by research from practices based mainly in folklore. A library of well-founded *Topic Papers* can be important to engaged management because it would provide a handy resource that validates previously researched practices, and a venue where practice-oriented researchers can preserve the most practical results of their research. The two rather diverse examples in this article are themselves timely: Moghadam reports the practical validity of using waste-to-energy practices as a treatment for energy and pollution problems, and Yates reports the practical validity of using hedge funds to improve endowment performance. The meta-analytical technique used in these examples is both unique and approachable. It solves the very *practical* problem of both critiquing the validity and combining the results of research proceeding from rather different paradigms (e.g. qualitative and quantitative). This diversity is a particular problem in evidence-based management that is less prevalent in other fields of evidence-based practice.

Critically Appraised Topic (CAT): Building a Library of Validated Practices

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ABSTRACT

We review the critically appraised topic (CAT) as an evidence-based tool in management research and provide original examples for consideration. The CAT is a highly condensed form of systematic literature review, collecting study findings to address a specific practice-oriented research question. Such questions often investigate the effectiveness of a known intervention. In addition, a CAT critiques the best evidence available by considering the rigor and validity of relevant published research. CATs consolidate investigations of research relevant to specific, practical treatments in the field. We include two different CAT examples from unique business settings to illustrate the fundamental elements and practices of CATs and to show how they can be applicable to different business sectors and areas of practice. Based on these examples, we illustrate how the CAT provides a method to enable academics and practitioners to articulate a practice-oriented research question; examine research; and evaluate, consolidate, and synthesize the available evidence. This format holds the potential to bridge the gap between the academic research world and the practitioners' world by providing valid research as a basis for practitioners to improve their decision-making.

Keywords: Critically appraised topic, CAT, evidence-based management, literature search, systematic review, waste-to-energy, hedge fund investing, endowment hedge funds

CRITICALLY APPRAISED TOPIC (CAT): BUILDING A LIBRARY OF VALIDATED PRACTICES

Decision making in evidence-based practice is informed by four major sources (Rousseau & Gunia, 2016). First, the decision process is informed by the experience of the decision makers. This experience is conditioned by the intelligence, courage, and creativity of the decision makers (among many other characteristics that gifted decision makers might bring to the problem). Second, the decision process is informed by the characteristics of the problem setting (the problem context). Such characteristics can include culture, prevalent modes of ethical reasoning, and historical factors. Third, the decision process is informed by diagnostic evidence from the problem situation. This diagnostic evidence can be obtained through empirical research methods (either qualitative or quantitative) that illuminate the problem situation. This evidence helps to assure decision makers that the problem diagnosis is well formed. The fourth major source available to decision makers is evidence about this *kind* of problem from the scientific literature. The scientific literature can help to lead decision makers through a diagnosis (i.e., what characterizes this kind of problem); it can help decision makers to find known interventions (i.e., what different interventions are known to have ameliorated this kind of problem); and it can help to assure decision makers that any chosen intervention is likely to have the desired effects. This fourth source of evidence dominates the short articles known as critically appraised topics (CATs). CATs focus on discovering evidence of effectiveness to support a possible intervention.

Background

A systematic literature review, also known as a structured literature review, is a research project that identifies the most complete set of scientific publications relevant to a particular topic or research question (e.g., Dybå & Dingsøy, 2008; Islam & Rahman, 2016; Kilubi, 2016; Massaro, Handley, Bagnoli, & Dumay, 2016; Savolainen, Ahonen, & Richardson, 2012). Such a literature review undertakes a rig-

orous methodology in the compilation, analysis, and evaluation of the findings and merits of these relevant studies. The review usually involves a meta-analysis (in the case of quantitative studies) or meta-ethnography (in the case of qualitative studies) as a means of summarizing agreements, contradictions, and gaps in the scientific literature. Systematic literature reviews tend to be thorough and lengthy reports related to broad research questions about what is known scientifically about a particular topic (Briner & Denyer, 2012).

A CAT is a highly condensed form of systematic literature review, usually reported in a very succinct article of only a few pages (Barends, Rousseau, & Briner, 2017). It often relates to a very narrow research question (Sadigh, Parker, Kelly, & Cronin, 2012), focused on the scientifically known effectiveness of specific treatments for specific problems. For example, a CAT often responds to a yes/no question about an intervention, such as, "Will an across-the-board compensation adjustment improve employee morale more than merit-based adjustments?"

The research question for a CAT also might be highly stylized. For example, the question might use a PICO format (Richardson, Wilson, Nishikawa, & Hayward, 1995):

(P)roblem: What is the problem for which a solution is being sought?

(I)ntervention: What solution is being considered as a means of treating this problem?

(C)omparison: What alternative solutions have been systematically compared to the solution under consideration?

(O)utcome: What are the known outcomes of the solution under consideration?

We can recognize this format as similar in structure to van Aken's (2004) technological rules, which allow for a coding of

technical knowledge for designing decisions (cf. Bunge, 1967). Thus, if you want to achieve Z in situation Y , then perform X . In our case, if we want to achieve outcome O in problem situation P , then perform intervention I .

CATs have potential as important elements in evidence-based management (EBM) (HakemZadeh & Baba, 2016). When circulated as part of the scientific literature, CATs provide investigations of widely used, practical treatments for problems in the field. When a broad range of CATs is available, other practitioners of EBM can more easily benefit from the body of previous research that uses scientific means to evaluate problems and solutions (Briner & Walshe, 2014).

Like many other forms of evidence-based practice, CATs originated in the field of medicine. In medicine, CATs enable practitioners to share scientific knowledge about specific treatments for specific health problems. They are an important tool for identifying and eliminating folklore as a basis for professional practice.

CATs frequently adhere to a highly structured outline; for example:

1. **The clinical question or scenario.** This question typically asks whether a specific treatment is effective against a specific problem. In management, it might also ask whether a particular strategy is an effective means for achieving a particular end.
2. **Background on this question or scenario (the problem).** This background comprises an effectively and concisely articulated definition and scope of the problem under consideration. It must be concise enough to exclude irrelevant studies but cannot be so narrow that it excludes the best of the relevant scientific research.
3. **Search strategy, method, and evidence selection.** Like all good science, the CAT should follow a strong methodol-

ogy for searching the scientific literature and determining how articles are selected for consideration in the study.

4. **Results: critical appraisal.** The critical appraisal of the articles concerns their relevance to the question and the rigor of the underlying study and evidence, as reported in the article. This appraisal is based on the criteria for accepting the study into the comparison; if the criteria are not met, the study is rejected from consideration in the CAT.
5. **Flow of discovery.** Often this step involves a graphical depiction of the method by which articles are identified, analyzed, and included in or excluded from consideration as evidence in the CAT. Figure 1 is an example of a flow of discovery graphic from a medicine-related CAT.
6. **Conclusion and comments.** The section is made up of comments about the collective evidence contained in the articles considered within the CAT.
7. **CAT limitations and strengths.** The section is made up of comments about the quality of the CAT itself.
8. **Recommendation.** This step provides the answer to the clinical question. Answers are usually written in a concise form but include a recommendation as to whether the treatment under consideration has practical benefits or utility.

The literature research strategy usually uses the same library tools as a systematic literature review. In management, two basic strategies often are combined. One strategy involves formulating search queries into databases, such as EBSCO and ABI Inform. For example, separate queries can be developed for each of the PICO elements and then combined. This approach often provides a fairly narrow set of research articles that are highly relevant for the CAT question (see Figure 1).

A second basic strategy operates from the basis of a highly relevant study in the literature, perhaps discovered using the first

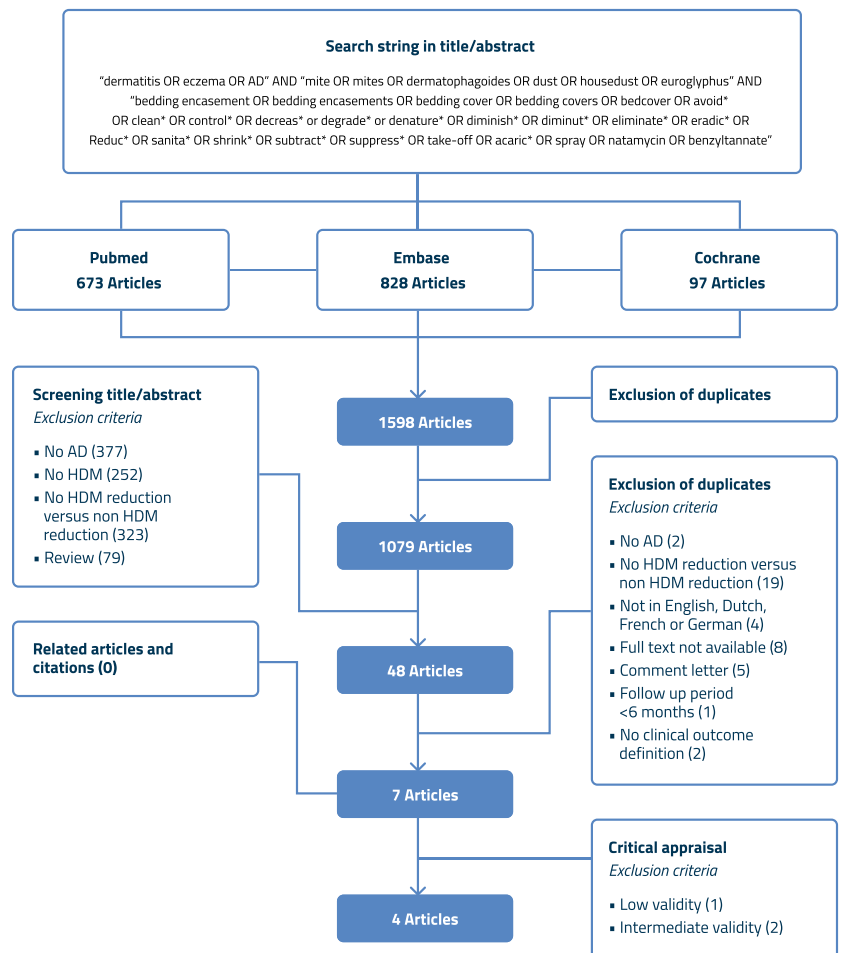
strategy. The strategy can search backward by searching the references used in the study, or search forward by using a citation search (such as Web-of-Science) to find more recent articles that have cited this study.

In contrast to the process in the field of medicine, where large-n, controlled experiments often prevail, development of a CAT in the management domain sometimes involves comparing and compiling research studies that have been based on rather different kinds of research methods. This problem arises from the diversity of research methods used in management research. A CAT developer might encounter relevant research based on surveys, field or lab experiments, action research,

scenarios, or case studies. In such situations, the CAT becomes more of an interpretation of the meaning of existing research than a quantitative compilation of homogenous experimental findings. For example, one approach to generating such an interpretation is based on a metaphor for culture: The CAT developer treats the differing research paradigms as differing research cultures. CAT developers then compile results as if the knowledge originated from different cultures. Such a subjective and interpretive analysis has been labeled a meta-ethnography (Noblit & Hare, 1988).

A meta-ethnography synthesizes the knowledge and understandings developed across diverse kinds of studies, even

Figure 1. Example of a flow of discovery graphic from a medical CAT (Garritsen, ter Haar, & Spuls, 2013).



when these studies arise from different scientific paradigms. Such paradigms can include studies from interpretive, qualitative, and ethnographic paradigms. We can extend these paradigms to include quantitative paradigms, such as field surveys and experiments. The synthesis itself will reflect the perspective of the synthesizer and tends to be inductive, ethnographic, and interpretive. Similar to quantitative meta-analysis, this synthesis involves the determination of a basic comparability between phenomena so that the knowledge and understandings can be accumulated and analyzed (Noblit & Hare, 1988). Noblit and Hare (1988) organize the process of meta-ethnography into seven phases, adapted below for use with management CAT development:

- **Phase 1: Getting started.** For CAT purposes, carefully developing and formulating the PICO is the first part of the process.
- **Phase 2: Deciding what is relevant.** For CAT purposes, the literature search strategies are used to identify the relevant studies. If the literature search produces too few studies (i.e., only one or two), the next step might be to revisit the PICO and search queries to include more general descriptions or terms (particularly synonyms) to discover knowledge that is relevant to the PICO, although perhaps less specific. If the literature search produces too many studies (i.e., twelve or more), it can help to narrow the PICO and the search to eliminate extraneous material.
- **Phase 3: Reading the studies.** In a manner similar to the practice of hermeneutics, the studies need to be read multiple times. Developing an understanding of how the first study one has read relates to the other studies is difficult until after all the other studies also have been read. Similarly, developing an understanding how the last study relates to the first study is difficult until the first study is reread in light of the last study.

- **Phase 4: Determining how the studies are related.** This determination can begin with a simple list of key phrases, ideas, findings, and conclusions from each of the studies. The lists can then be compared to identify similarities and differences. The lists also can reveal agreements and disagreements on outcomes and levels of analysis (i.e., how the studies break down the characteristics of the problem, the intervention, and the outcome).
- **Phase 5: Translating the studies into one another.** Translation involves first determining how each particular study's key ideas relate to (or interact with) the other key ideas in that study. Then, each of the other studies is examined to see if these key ideas and their key relationships (or interactions) are present.
- **Phase 6: Synthesizing the translations.** Synthesis involves interpreting the translations to identify similarities among them. For example, one translation might be a more general version of several others. Alternatively, interpreters might be able to formulate a general translation that embodies several others. In other words, synthesizing involves finding the kinds of translations that are present throughout the body of works.
- **Phase 7: Expressing the synthesis.** The conclusions and comments section of the CAT delivers the synthesized translations from the discovered

body of relevant works. Because a CAT is a succinct document, many CATs conclude by summarizing the results of the translation synthesis, with a specific focus on the terms of the PICO question. Additional comments might describe specific study translations where a specific element is important for understanding the conclusions.

In this process, Phases 4 and 5 are perhaps the most difficult because the notion of key ideas is often quite broad. For example, consider a set of research studies that includes experiments, surveys, case studies, formal models, grounded theory studies, ethnographies, and conceptual theory pieces. Each paradigm uses different sets of elements to construct different kinds of relationships and interactions. Examples of these differing elements and differing relations are shown in Table 1. Phase 4 involves listing the specific elements, relations, and interactions in each study and comparing these factors to identify similar and dissimilar ideas across the studies. Phase 5 involves translating both similar and dissimilar ideas across studies in search of confirmation or disconfirmation of the effectiveness of the proposed intervention. As with other kinds of qualitative analysis, the goal is to determine the dependability of the outcome for the proposed intervention in the kinds of problem settings given by the studies (Lincoln & Guba, 1985).

Table 1. Examples of differing key ideas in six different research paradigms.

Paradigms	Elements	Relations and Interactions
Experiments and surveys	Constructs, variables	Hypotheses
Case studies	Events, phenomena, factors	Dependencies, explanations
Formal modeling	Variables	Mathematical expressions
Grounded theory studies	Categories	Axial and selective coding
Ethnographies	Values, behaviors, Artifacts	Breakdowns, resolutions
Conceptual theory pieces	Concepts, causes	Propositions

CAT Application

A primary goal of engaged management is to marry the vast amount of research conducted by academicians across myriad fields to the real-world, day-to-day experiences of practitioners. The hope is that by using this research, engaged managers can create better outcomes for their business. The following two CATs are based on actual questions that arose from practitioners who sought solutions to problems they experienced while engaging in executing their business. These two examples come from two distinct fields: finance and energy.

In the first example, author Jahan Moghadam, seeks to answer the question of whether renewables are a viable alternative for addressing the lack of reliable energy production in developing countries while also reducing pollution problems there. In the second example, author Samuel W. Yates wants to explore the role of hedge funds in endowment asset allocation. In each of these disparate examples, research had been done using the techniques described in the CAT review process; and even before the conclusion of this research, the respective engaged managers were able to get up to speed in a relatively short time.

In the rest of this paper, we first present the two CATs in their entirety. We then conclude by examining the success of the CAT methodology for providing evidence-based answers to complex questions that arise in the course of doing business.

CAT 1: WASTE-TO-ENERGY (WTE) AS A SOLUTION FOR ENERGY POLLUTION PROBLEMS

I am President of both WorldWide Energy (WWE), which is in the energy and infrastructure sector, and sister company WorldWide Solutions (WWS), a consulting and training firm. Part of WWE's portfolio is a renewable energy technology, solution known as Waste-to-Energy (WtE). One of my roles involves overseeing business development and strategy, which is to promote WWE's WtE solution to potential clients. With everyday environmental and energy societal concerns, WWE is trying to persuade the public and private sector to move from conventional energy sources that pollute the world (such as coal) to using renewable solutions like WtE.

Educating the public on WtE is very important because it shows the tremendous benefits to solving global environmental problems and also creating clean, sustainable energy. The goal for the following CAT was to see what research exists on WtE as a means to address energy pollution rather than relying on my own experience, which might include possible bias toward WtE and its benefits.

Research Question

The research question for this CAT is: Can WtE contribute to solving the energy crisis and pollution problems?

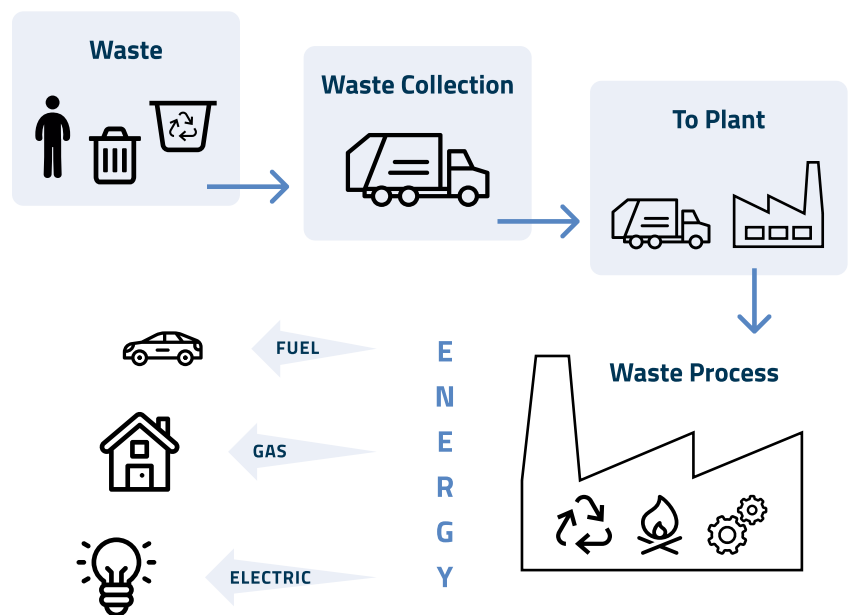
Background

The use of renewable energy (RE) has increased considerably in the past several years because of innovative forms of sustainable alternative energy production, such as WtE. WtE is an innovative and evolving form of RE (see Figure 2). Countries worldwide face two common challenges: 1) energy production and 2) high levels of pollution. WtE implementation could serve as a solution to both challenges. This CAT examines current literature to examine WtE's benefits as a possible solution to both energy and pollution concerns.

Search Strategy

I conducted a methodical search using ABI Inform Collection, Web Science, and EconLit. I assessed articles from all three platforms related to the research question. "WtE" was included in the screening of journals.

Figure 2. Waste-to-Energy (WtE) process (adapted from Re-Gen, 2016).



I used a thesaurus in each search platform; however, I made infrequent word changes because of the technicality and specificity of the subject, waste-to-energy. Each platform had suggested text (e.g. when I type WtE, it proposes common search words), a few of which were added as AND terms for waste-to-energy forms of texts. I screened the studies to include only recent English-language, peer-reviewed research publications from 2009 to the present.

Results

An initial search was conducted on each of the three platforms individually, resulting in 26,470 articles. Then, I included a second round of screening, narrowing the search results by adding “AND energy production” and “AND pollution reduction,” along with the specification of peer-reviewed journals. The search resulted in 682 papers. A third round of screenings excluded studies that were not conducted between 2009 to 2017, were trade jour-

nals or working papers, or were not in English, which resulted in 69 papers. With a final screening, I excluded duplicates and then focused on a number of topics and abstract reviews, seeking key words and a distinct storyline. The final assessment resulted in seven articles. Figure 3 illustrates the flowchart for the search and selection approach of articles and criteria.

Figure 3. Flowchart of search approach for CAT 1.

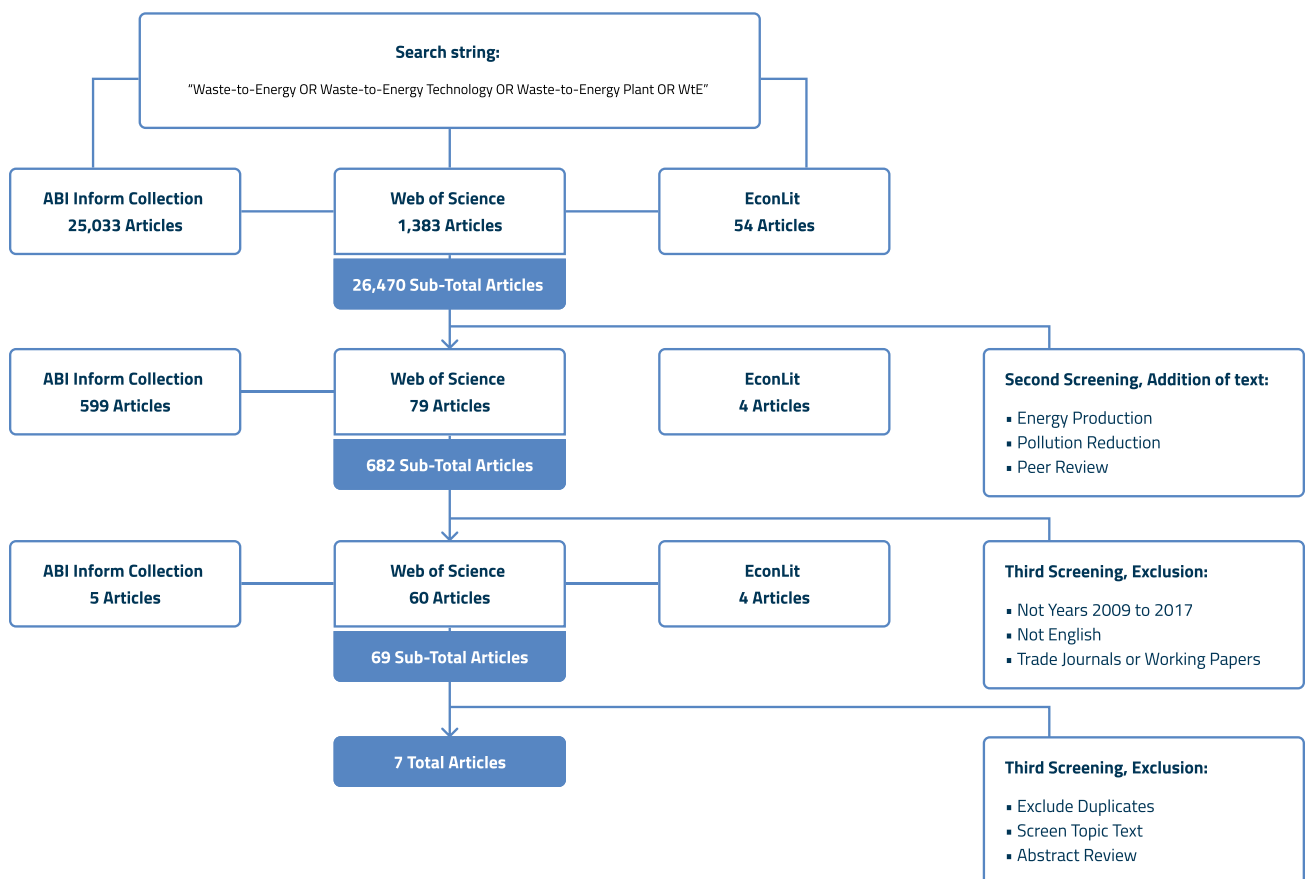


Table 2. Critical evaluation of overall validity of the seven studies.

	Research Approach	Empirical Basis	Analysis Method	Overall Validity
Study 1 (Ata, Lee, & Tongarlak, 2012)	Modeling	Rural and urban characteristics of WtE operation, waste disposal, energy, and policies for renewable energy, used to determine profit-maximizing strategy.	Numeric Analysis	Conclusion drawn from numeric modeling on best economic benefits.
Study 2 (Jamasb, Kiamil, & Nepal, 2008)	Conceptual Argument/ Feasibility Study	UK policy and WtE management.	Social and cost-benefit analysis	Conclusions drawn from benefit results
Study 3 (Kessides & Wade, 2011)	Modeling	Energy creation analysis.	Numeric analysis	Conclusions drawn from social and cost-benefit analysis
Study 4 (Nikolic, Mikic, & Naunovic, 2017)	Feasibility Study	Energy plant combing heat with WtE in Belgrade (Capital of Serbia).	Financial and economic analysis	Conclusion of WtE is that it is financially and economically positive and viable.
Study 5 (Orge & McHenry, 2013)	Case Study	WtE prototype created in Philippines community	Direct observation of demo WtE	Working prototype, with good working conclusions.
Study 6 (Ouda et al., 2016)	Case study / Feasibility Study	Kingdom of Saudi Arabia	Numeric analysis	Conclusion drawn from social and cost-benefit analysis.
Study 7 (Alexander, 2016)	Conceptual Argument	New York		Lacks validity: little backing of arguments and claims

Table 2 describes a critical evaluation of the overall validity of the seven studies.

Table 3 lists the key findings of the studies and relates them to each other, with the resulting translations of the collective findings.

With the exception of study 7, which was dropped because it lacked validity, these studies collectively offer similar views of WtE and of the benefits from its use. Multiple studies show that WtE improves the environment because it reduces waste in landfills (Finding 1). Multiple studies have indicated that WtE is a renewable energy source (Finding 2). Other research shows that it can be part of an ideal energy economy (Finding 3). At least one study finds it is promising for helping serve energy needs in remote communities (Finding 4).

In addition to these four findings, this CAT also revealed some reservations about WtE. For example, one study raises concerns about whether WtE can produce adequate quantities of power (Kessides & Wade, 2011), and one found significant costs in switching from fossil fuels to renewable WtE (Ouda et al., 2016). My translation of these reservations is that some of the most valuable WtE applications can serve remote places with low power demands. Such applications include mining operations, farming communities, and some tourist destinations. These reservations aside, I find a consensus among all six studies regarding the benefits of implementing WtE, not only as a leading renewable energy source, but also as a technology for power generation. All studies agreed that WtE reduces pollution.

The majority of this research shows financial and economic benefits. I conclude from these studies that WtE is one solution to the global energy demand and pollution crisis. WtE is a positive technology that can resolve environmental and energy challenges in urban and rural areas.

Conclusion

From the evidence gathered in the journals, WtE has several benefits for energy creation that can help to address power production issues and that can be advantageous compared to traditional energy sources. WtE has shown that it would be economically positive (Nikolic, Mikic, & Naunovic, 2017). In addition, by reducing pollution, WtE addresses environmental concerns, such as global warming, and it can be applied in both advanced and developing countries.

Table 3. Key findings with the resulting translations of the collective findings.

	Finding 1	Finding 2	Finding 3	Finding 4
Study 1 (Ata, Lee, & Tongarlak, 2012)	WtE has a significant role in creating a sustainable industrial ecosystem.	Converting waste to energy is an economically beneficial use of waste management.	WtE has a significant role in creating a sustainable industrial ecosystem.	Benefits to social welfare and to environmental impact. Findings lead to possible further research.
Study 2 (Jamasb, Kiamil, & Nepal, 2008)	WtE is an effective option for waste management and energy creation.	WtE can minimize waste to landfill and has cost benefits when used for waste management.	WtE can contribute toward addressing the UK's climate change and renewable energy goals.	Decreases reliance on imported oil, improving security of energy supply.
Study 3 (Kessides & Wade, 2011)	Public policies can help promote renewable energy as an energy creation infrastructure source.	Climate change can be addressed by the use of renewable energy.	There is a need to assess renewables benefits to the global energy market.	Paybacks can be challenging for renewables in transitioning from fossil to non-fossil energy sources.
Study 4 (Nikolic, Mikic, & Naunovic, 2017)	WtE technology is efficient at creating ample energy from MSW.	WtE will reduce the amount of coal burned in power plants, which is currently used in Belgrade.	WtE is financially and economically positive.	A WtE feasibility study paves the way for other cities and urban areas to implement WtE.
Study 5 (Orge & McHenry, 2013)	WtE reduces the liabilities of food producers by increasing energy for use and for fertilization; increase can boost agricultural food production.	Preventing dumping or setting fire to waste creates a cleaner and safer alternative for waste management.	WtE tech is scalable and can be used for other infrastructure sources, such as pumping water.	WtE resources can be useful for lower income rural areas.
Study 6 (Ouda et al., 2016)	There is a global trend toward renewable energy production, especially WtE.	WtE exhibits the potential for growth and preference because of its efficiency and the potential decrease of pollution to the environment.	WtE has immense possibilities in power generation due to abundant amount of waste streams.	WtE can be a leading technology for power generation in renewable sources, can elevate the cost of creating more landfills, and can help reduce environmental issues (e.g., global warming).
Translation	WtE is a waste management strategy that benefits the environment by reducing waste in landfills.	WtE is a renewable energy source.	A high-waste source with low-power demands is economically ideal.	WtE energy can serve isolated communities.

In addition to the findings in the studies, several contributions illustrated potential uses of WtE. One study showed two significant benefits of using WtE: 1) It diverts waste from going into landfills, and 2) it produces renewable energy (Ata, Lee, & Tongarlak, 2012). Another study showed WtE can be an important part of both a waste management strategy and a renewable energy strategy (Jamasb, Kiamil, & Nepal, 2008). Along with energy pro-

duction, WtE can reduce the waste volume that is generally sent to landfills (Jamasb et al., 2008). Dependence on fossil fuels (especially the import of fuels) is reduced through WtE, providing a secure supply of energy (Jamasb et al., 2008). WtE also is scalable and can be located in rural areas, providing energy in areas outside of power grids (Orge & McHenry, 2013).

Thus, WtE could make a considerable contribution to renewable energy production, with a potential for significant power generation and for reducing landfill use and costs, all of which has positive environmental effects (Ouda et al., 2016). WtE can be used on a small or large scale to produce energy and other commodities (e.g., fertilizer) while also addressing environmental issues (Orge & McHenry, 2013). Further, WtE has shown that it is

economically positive and feasible (Nikolic et al., 2017).

Limitations

Some papers discovered in this CAT show that WtE has some limitations. One study (Kessides & Wade, 2011) found that energy output from renewable energy is low in comparison to nuclear energy. This study also found that transitioning from fossil fuel energy creation to renewables could have obstacles, including the cost to cross over to the new technologies. One concern was that rural areas might not produce enough feed (waste) for WtE to create abundant amounts of power, which might increase operation costs because of the need to transport large amounts of waste for the WtE system (Ata et al., 2012). On the other hand, Orge and McHenry's (2013) study showed that WtE does work in a rural setting. Finally, the general lack of knowledge about WtE seems to hinder its adoption; the public views it as just another polluting energy source, if they are aware of it at all.

Recommendations

The literature studied in this CAT indicates that WtE is a viable technology solution that can help to solve energy production and pollution concerns as a renewable energy source, compared to other conventional energy sources that have a negative environmental impact. To effectively address the limitations identified, WtE companies should build awareness and education of WtE and promote the benefits of its use. Future research should focus on examining concerns raised in the studies on WtE with regard to government authorities and policies for implementing WtE.

Greater awareness of WtE can be achieved through educational programs on WtE technology and its use for the general public; these programs can help promote knowledge and awareness of WtE as a plausible solution for energy production and pollution reduction. WtE companies need to take the initiative to build awareness and education and to effectively

promote WtE as a plausible solution for energy production and pollution reduction. Environmental advocates and members of the scientific community can help WtE to achieve its full potential by playing a vital role in the education process – both for the public and for policymakers – on the benefits of WtE use (Jamasp et al., 2008).

CAT 2: ENDOWMENTS AND HEDGE FUNDS

I am a Managing Director and Senior Consultant for an international investment bank. One of my roles is allocating and managing endowment portfolios for universities. An important part of this function is working with the various boards of these institutions to guide and educate them on becoming financially literate so that they can successfully fulfill their fiduciary responsibilities of oversight of the endowment. Board members of these institutions generally are successful in their chosen careers, but they serve in their position on a board as volunteers, and the levels of financial acumen among them are almost always as varied as the number of board members.

The motivation for the following research question was from an actual question that a board member raised. The discussion centered on why we were allocating assets to hedge funds and whether this allocation was a good use of resources. The general belief of this particular board was that hedge funds were "black box" investments that were impossible to understand and only existed to enrich the hedge fund manager. Rather than express my contrary opinion based solely on my own experience, I chose to investigate the question using evidence-based management practices and the tool of a critically appraised topic (CAT) in particular. The following CAT informed and educated university board members on what the research had to say about the role of hedge funds in endowment asset allocations.

Research Question

The research question for this CAT is: Do hedge funds have a role in endowment asset allocation?

Background

A hedge fund is defined as an alternative investment vehicle that houses many different investing strategies with the goal of superior risk-adjusted performance for the manager. Hedge funds often are part of an overall strategy that endowments

use to deliver superior returns on their assets; however, no systematic literature review currently is available that can clarify the role that hedge funds play when they are part of an overall asset allocation strategy for endowments. This review could lead to a more structured approach to understanding the value of allocating endowment monies to hedge funds.

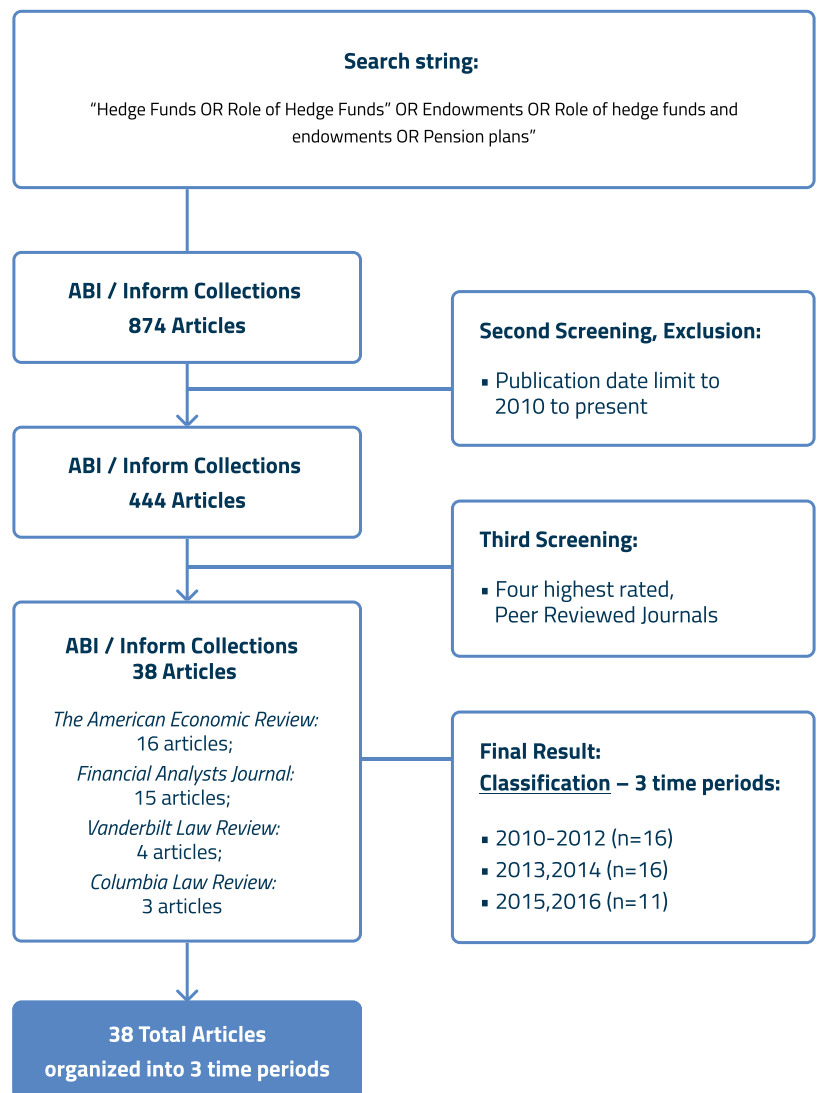
The purposes of this CAT are to review the literature available, summarize the current

knowledge on the subject, and ferret out new opportunities and questions for further academic research on this important topic.

Search Strategy

Using the data source, ABI/Inform collections, I performed a systematic search of relevant studies from 2010 to 2016. The searching targets I used included the title of the article, keywords, and abstract. The key words and phrases that I searched

Figure 4. Flowchart of search approach for CAT 2



were: “hedge funds”; “role of hedge funds”; “endowments”; “role of hedge funds and endowments”; and “pension plans.”

This initial search generated 874 articles. I then refined my limit to include only peer-reviewed articles, yielding 444 articles. Next, I refined my search by limiting the results to the four highest rated academic journals, which resulted in 38 articles. These journals included 16 articles from *The American Economic Review*; 15 articles from *Financial Analysts Journal*; 4

articles from *Vanderbilt Law Review*; and 3 articles from the *Columbia Law Review*. The distribution of the articles, by year, fell into three time periods: 2010–2012 (n=16); 2013–2014 (n=16); and 2015–2016 (n=11). Figure 4 illustrates this search strategy and results.

Results

Table 4 describes a critical evaluation of the overall validity of the six studies.

Table 4. Critical evaluation of the overall validity of the six studies.

	Research Approach	Empirical Basis	Analysis Method	Overall Validity
Study 1 (Brown, Dimmock, Kang, & Weisbenner, 2012)	Modeling	Data collected from more than 200 doctoral universities with endowment data available through the NACUBO surveys	Statistical inference	Strong r2
Study 2 (Geddes, Goldberg, & Bianchi, 2015)	Modeling	Calculation using a modified version of the traditional mean-variance optimizer.	Simulation	<i>Prima facie</i> results, minimum use to problem
Study 3 (Goyal & Wahal, 2008)	Formal model	“Obtain return information from Mercer’s Manager Performance Analytics database. This database contains quarterly returns (gross of fees) on approximately 9,000 products offered by 1,200 investment managers for the period from 1981 to 2005” (p. 1815).	Statistical inference	Strong r2
Study 4 (Ellis, 2012)	Survey	Data obtained from Greenwich & Associates of mutual fund performance over a one-, ten-, and twenty-year time period	Statistical inference	Perspective piece
Study 5 (Rogers, 2014)	Editorial	Federal Reserve data from 2007 to 2009, collected from the top 1,000 pension funds	SEM	Conclusion drawn from data
Study 6 (Fallon, Park, & Yu, 2015)	Modeling	“The 34 unique underliers we used [were] from four global macro asset classes—equities, fixed income, currencies, and commodities. In each asset class, we selected assets representing a variety of regions or sectors, emphasizing economic significance and both historical and current market liquidity” (p. 40).	Statistical inference	Strong r2

Table 5 lists the key findings of the studies and relates these to each other, with the resulting translations of the collective findings.

Table 5: Key findings of the studies.

	Finding 1	Finding 2	Finding 3	Translation
Study 1 (Brown, Dimmock, Kang, & Weisbenner, 2012)	"Document the effect of negative endowment shocks on university operations, including personnel cuts" (p. 931).	"Endowments actively reduce payouts relative to their stated payout policies following negative, but not positive, shocks " (p. 931).	"The asymmetric behavior is consistent with 'endowment hoarding'" (p. 931).	(Studies 1, 3, & 4) Emotional reactions to downward movement in the markets and the negative costs associated with it
Study 3 (Goyal & Wahal, 2008)	"If plan sponsors had stayed with fired investment managers, their excess returns would be no different from those delivered by newly hired managers" (p. 1805).	"Uncover significant variation in pre- and post hiring and firing returns that is related to plan sponsor characteristics" (p. 1805).	"Plan sponsors hire investment managers after large positive excess returns, but this return-chasing behavior does not deliver positive excess returns" (p. 1805).	
Study 4 (Ellis, 2012)	"Data show that in a random 12-month period, about 60% of mutual fund managers underperform ; lengthen the period to 10 years and the proportion of managers who underperform rises to about 70%. Although the data are not robust for 20-year periods, the proportion of managers who fall behind the market for this longer period is about 80%" (p. 13).	"New research on the performance of institutional portfolios shows that after risk adjustment, 24% of funds fall significantly short of their chosen market benchmark and have negative alpha; 75% of funds roughly match the market and have zero alpha; and well under 1% achieve superior results after costs—a number not statistically significantly different from zero" (p. 13).	"Costs also matter far more than most investors realize. Investment management fees are not 'low'" (p. 13).	
Study 2 (Geddes, Goldberg, & Bianchi, 2015)	Hedge funds make up well over 25% of the Yale Endowment. Because Yale is a nontaxable entity, the use of alternatives in general and hedge funds in particular is both appropriate and useful to mitigate downside movements of the overall portfolio.	Demonstrate the effect that taxes can have on optimal portfolio weights, as well as the interplay between taxes and risk. There still is a place for alternatives in the overall portfolio; however, they are more costly to taxable investors in providing the benefits of downside mitigation.	Once taxes are included, this model tends to lower allocations to tax -inefficient asset classes, such as hedge funds, and to increase allocations to tax-efficient strategies. With optimal tax management, hedge fund allocation can still be preserved, as long as their returns are uncorrelated with those of equity returns.	
Study 5 (Rogers, 2014)	"Encourages long-term thinking. As 'universal owners,' fiduciaries foster a deeper engagement with companies' management teams and public policymakers on governance and strategy" (p. 6).	"Fiduciary capitalism would be one in which long-term -oriented institutional investors shape behavior in the financial markets and the broader economy" (p. 6).	Found that some hedge funds are uniquely positioned to aid in long-term growth, which is a hallmark of fiduciary capitalism.	
Study 6 (Fallon, Park, & Yu, 2015)	" Shorting volatility offers not only a very high and statistically significant Sharpe ratio of approximately 1.0 but also substantial tail risk" (p. 38).	"Authors show that modest allocations to short volatility exposure could have enhanced long-term returns, in one case increasing the portfolio's combined Sharpe ratio by 12%" (p. 38).		
Translation	Prudent use of volatility management, which is a part of hedge fund allocation, is useful to the long-term viability of an endowment.			

These studies collectively offer separate and distinct views on roles for hedge funds in endowments asset allocations. Table 5 illustrates these views with both horizontal and vertical summaries of how I translated these studies in light of each other. Horizontally, my translation of the findings in studies 1, 3, and 4 show the emotional reactions to downward movement in the markets and the negative costs associated with it, while my translation of studies 2, 5, and 6 shows the salutary effects that a hedge fund allocation can have on a diversified portfolio. In Findings 1 and 2, vertical translation of these findings in all six studies shows that prudent use of volatility management, which is a part of hedge fund allocation, is useful to the long-term viability of the endowment and the people it benefits. The above groupings provided the necessary foundation to critically address the question asked. I then interpreted the aggregate material to reach a valid and defensible conclusion.

Conclusion

My search resulted in a fairly even distribution of articles across each year; the highest number published in one year was eight articles – in 2012, 2014, and 2015 – and the lowest number published was three articles – in the years 2010, 2013, and 2016. Articles discussing either particular, individual investment strategies or broad macro-themed investment ideas made up the majority of the search returns, with 19 articles. The second highest category (nine articles) involved miscellaneous topics, such as corporate compliance, that consequently were not appropriate for this research question. The most valuable articles in relation to this question and that are a basis for further research are the articles that focus on the investor, the endowment, or the overall allocation of the endowment; seven articles fell into this category, and I have included them in the reference section of this paper. Finally, three articles focused on three separate theories in regard to this endowment topic. Agency theory continues to dominate in finance, and most of the papers that mentioned theory used agency theory as their

basis. The other two theories mentioned were full equilibrium theory and life-cycle theory. *Financial Analysts Journal* seemed to be the publication of choice for research on this topic, publishing six of the seven relevant articles. *The American Economic Review* had the sole other useful article, and neither of the law review journals proved useful for this research question.

The articles reinforced the assumption that hedge funds and other alternatives are seen as a key building block in many endowment portfolios. Hedge funds are viewed as balances to volatility within the portfolio. Although hedge fund allocations vary greatly, they generally become larger, both in absolute terms and in percentage terms, as the endowment grows. An allocation to hedge funds is seen as a fiduciary responsibility.

In their paper, “Asset Allocation Implications of the Global Volatility Premium,” Fallon, Park, and Yu (2015) examined the volatility premium and its role in institutional portfolios. They found that short volatility exposure could have long-term beneficial effects on the portfolios, increasing their aggregate Sharpe Ratio by 12 percent or more.

The paper by Brown, Dimmock, Kang, and Weisbenner (2012) discusses the implications of negative investment shocks on the payouts of endowments. When negative shocks affect the markets, endowments tend to reduce their payouts to below their distribution goals. The logical result of this reduction is a negative effect on operations, such as layoffs of personnel. This behavior is termed *endowment hoarding* and is particularly pronounced at the beginning of the term of a new university president. The portfolio is evaluated at that time and benchmarked, and many investment and distribution decisions are made that have long-term consequences for the endowment and the university it serves. Brown et al. conclude that hedge fund investments would reduce endowment hoarding because the returns ameliorate a portion of the downside volatility of the overall portfolio and thus benefit

the end recipients who rely on the endowment for funding.

Meanwhile, Ellis (2012) focuses on the underperformance of endowments and its cause. He examines four distinct groups to determine who bears the greatest responsibility for underperformance: investment managers, fund executives, investment consultants, and investment managers. The largest problems come in two forms across all 4 groups: groupthink and buying high and selling low. On the first point, the social and political aspects of the endowment or pension plan come into play. On the second point, endowment decision makers tend to chase “star performers” when allocating to various investment classes; in Ellis’s estimation, however, past performance doesn’t predict future performance.

Geddes, Goldberg, and Bianchi (2015) describe how an investment allocation might be different for the Yale Endowment if it were taxable. For our purposes, the ancillary points that the authors made are quite telling: Hedge funds make up more than 25% of the Yale Endowment portfolio; their returns are generally uncorrelated to the rest of the portfolio; and they are set up for consistent, positive, aggregate returns. Uncorrelated returns dampen portfolio shocks and deliver more consistent returns. In addition, Yale Endowment investors assume an annual ROI goal of 4% plus annual returns and build their risk around this assumption.

Rogers (2014) coined the term *fiduciary capitalism* and advocates for its adoption. According to Rogers, fiduciary capitalism is defined as “one in which long-term-oriented institutional investors shape behavior in the financial markets and the broader economy” (Rogers, 2014: 6). Endowments and foundations are certainly part of this group, and they have a responsibility to connect the investments they make to a larger economy. Rogers also argues that some hedge funds are uniquely positioned to help fulfill this role on behalf of their clients.

Recommendations

Despite Ellis's findings that most equity mutual funds either underperform or provide zero alpha to their benchmark, as performance does tend to persist in mutual funds (Brown & Goetzmann, 1995; Grinblatt & Titman, 1992) and hedge funds (Agarwal & Naik, 2000). In other words, winners continue to win (outperform their benchmark) and losers continue to lose (underperform their benchmark) The problem is that investors tend to discover the "stars" only *after* a run of overperformance (Goyal & Wahal, 2008); and the end of a strong performance cycle generally is the *worst* time to buy into these portfolios or to invest with the manager because the portfolio might not overperform again for quite some time.

Collectively, these papers tell a story about the place of hedge funds in the asset allocation of an endowment. Hedge funds have a long-term beneficial effect for endowment portfolios, increasing their aggregate Sharpe Ratio by 12+ percent annually. Based on these articles, the following recommendations can be made:

Don't chase stars. Do the fundamental work to identify consistent top performers, and invest prudently; do not invest immediately following a period of substantial outperformance.

Invest in hedge funds that are not correlated to the market. Use absolute return funds that provide consistent returns over long periods of time. This approach reduces shocks to the cash flow stream and provides for better expectation management.

Invest in hedge funds to reduce "endowment hoarding"; in doing so, the end beneficiaries can function with better guidance and security because cash flows and disbursements are more consistent.

Become fiduciary capitalists. That is, look toward investing for the next 50 years, rather than for the next month or quarter.

The role of hedge funds is essentially to be an anchor in the portfolio, providing consistent returns that are not correlated to the rest of the portfolio. In this one area, the endowment is not correlated to the overall market, and endowment managers need to pay particular attention to volatility. If they manage this area properly, it can greatly benefit the rest of the portfolio.

Limitations

This paper has limitations. First, the recommendations are based on a relatively narrow range of papers. Second, hedge funds are structures that encompass a wide variety of investment options (Yates, 2017) so the underlying investments need to be the focus and not the structure in which the manager gets paid.

Table 6. Comparison of the CAT examples.

CAT	Waste-to-Energy (WtE)	Role of Hedge Funds
Field	Energy/renewable energy/pollution	Investments
Scope/Motivation for Question	Broad: meant to begin a larger conversation on how to solve two major issues (the proliferation of waste and the expense of energy)	Specific: should an endowment have an allocation of hedge funds in its portfolio?
Target Audience	Governments/industry	Endowment boards
Yes/No Research Question	Can WtE contribute to solving the energy crisis and pollution problems?	Is there a role for hedge funds in endowment asset allocation?
Search Engine	ABI Inform Collection, Web Science, and EconLit	ABI Inform Collection
Method	PICO	PICO

Conclusion

The article examined CATs as a condensed form of systematic literature review, accumulating research to address a specific, practice-oriented research question. The two examples of CATs covered two different disciplines: energy and pollution and finance. Accordingly, the two CATs vary in a number of ways, including organization, format, and mechanics of translation. Table 6 shows a comparison of other aspects of the two sample CATs given in this paper.

Value of CATs for the Practicing Manager

The goal of engaged managers is to use the tremendous resources in academic research that are available to them to solve practical problems that they face in their business. Senior executives often turn to management consultants to address their specific situation. A well-researched and well-executed CAT can provide a meaningful starting point and answers for the problem at hand.

The two CATs covered two widely different disciplines (renewable energy and finance). Each addressed a specific question of the researcher:

- Can WtE contribute to solving the energy crisis and pollution problems?
- Is there a role for hedge funds in endowment asset allocation?

To address these questions, the researchers went to the academic literature and sought answers based on research that had already been conducted. By its design, a CAT represents a condensed form of research that addresses practical problems. We suggest that a CAT might be viewed as a sort of “bridge” between the academic and practitioners’ worlds. A tremendous benefit of the CAT is its replicability and flexibility: A reader of any CAT can easily follow steps described in the process to arrive at the same end point, and if they have a slightly different question, they can deviate and refine their question to reflect their specific problem. In addition, its short form makes a CAT easily accessible and digestible by practitioners who have less experience in, and little time for, reading academic publications. In short, it is a tool for disseminating rigorously produced ac-

ademic knowledge among professionals. Developing and using CATs as a resource can be an integral link between the worlds of researchers and practitioners: The academic reaches a broader audience, and the practitioner can use existing research to answer real-world questions.

The following guidelines, developed from the first CAT example presented in this paper, can help engaged managers who would like to use the CAT process to derive conclusions to address a business problem, to publish academically, or both. Consider the following question, answer, and action resulting from this CAT:

Question: Can WtE contribute to solving the energy crisis and pollution problems?

Answer: Yes; WtE is a viable technology solution that will help solve energy production and pollution concerns as a renewable energy source compared to other conventional energy sources that have an environmental impact.

Action: Greater awareness of WtE technology and its use is needed among the general public; educational programs can help to promote knowledge and awareness of WtE as a plausible solution for energy production and pollution reduction. WtE companies need to take the initiative to deliver information to the public to effectively promote WtE as a plausible solution for energy production and pollution reduction. For WtE to achieve its fullest potential, private and public organizations need input from commercial and municipal waste management systems to create policies that advance WtE use (Jamasp et al., 2008).

The author generated the appropriate action by beginning with a relevant question, going through the process using the PICO framework, and arriving at a handful of articles that would provide information about the cutting-edge research regarding the question. He then did the work of deeply reading the articles and interpreting them in light of his question. The published CAT has two essential ingredients:

first, a thorough and replicable search that is recorded and demonstrated; and second, and more critical, an interpretation of the queried articles to generate an answer to the question, thus extending or contributing to knowledge production by offering insights and recommendations that can be acted on. In the WtE case, the author directed the actionable knowledge toward a large audience. Governments, WtE companies, and environmental advocates all were encouraged to educate the public to build a groundswell of demand for this useful and viable technological solution to two of the world's most pressing problems. A successful CAT has both the effective search and the actionable interpretation.

Collectively, the authors found the CAT process to be an effective and targeted way to seek out research that contributes to their respective industries' concerns. CATs represent an opportunity to provide professional colleagues, clients, and board members with academic information in a systematic and direct manner; and they open the eyes of professional networks to the benefit of academic research to support business goals. The ability to circulate relevant academic studies in professional settings is a tremendous strength of the CAT process. Moreover, the ability to share the findings with our respective audiences converted the tedious and time-consuming process of developing the CAT question, researching the CAT findings, and compiling the key information into a valuable effort. Academic studies can be important to our professional fields but are not widely used among practitioners. The CAT process encourages practitioners to research in a straightforward and effective manner, confirming perceptions with data and providing new insights for consideration.

One limitation of CATs, from the academic point of view, is the subjectivity with which CAT authors choose the academic articles. By design, CATs focus on answering a very

narrow (often yes or no) question and are limited to several printed pages in length. Therefore, from a practical point of view, researchers must limit themselves to a narrow range of articles that represent the most crucial arguments for the matter at hand. As the examples in this paper show, the flow of the article selection process starts with objective criteria (e.g., whether the article is published in a peer-reviewed journal and the date of publication). However, in later stages, the authors selected articles based on reviews of the abstracts, which implies some degree of subjectivity. Although the same can be said about a systematic literature review, CAT authors should make sure that, when possible, they offer readers different points of view on the question being researched.

A second limitation emerges if CATs are used as a shortcut to replace a proper academic study. CATs aggregate others' research, and CAT authors then draw their own conclusions. That CATs are, in essence, a smaller literature review and do not extend or add to knowledge in a field is a critical distinction; they are simply a way of answering a yes or no question using the available research.

A final limitation is that, similar to management consulting studies, a CAT may be a useful answer only to the individual researcher and his or her current business situation. Researchers thus need to recognize the boundaries of their work and not overgeneralize their findings.

This article shows how CATs can be an effective tool in assisting business practitioners. Practitioners have a few options for accessing such database libraries. Google Scholar can return a broad range of academic papers, from peer-reviewed articles to news articles and more on a vast array of topics. A second option is to join a research center, such as the Center for Evidence-Based Management (CEBMA).¹ This center provides evidence-based resources to managers to help make busi-

ness decisions. As a third option, many companies are developing affiliations or partnerships with universities, with whom they can strategize to gain support and to gain access to faculty, students, and resources, such as university libraries.

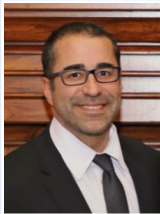
As we have shown, CATs are effective tools for both academics and professionals to apply research, and we have illustrated their usefulness in this paper for business leaders. CATs prove to be an effective and beneficial tool for extending the knowledge produced via academic research to the business world and other fields.

¹ <https://www.cebma.org/>

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