**Paradigmatic Approaches Used in Enterprise Resource Planning Systems Research: A Systematic Literature Review**

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**ABSTRACT**

The purpose of this paper is to determine the range of research paradigms employed in a subset of the Information Systems (IS) literature, namely Enterprise Resource Planning (ERP) systems. A systematic literature review based on papers that mentioned ERPs was drawn from eight of the most highly ranked journals according to their h-index. The findings indicate that the majority (96.6%) of the papers on ERP systems described research that was conducted within a positivist research paradigm, which is a far higher proportion than is suggested by other research in the general IS literature (approximately 81%). Paradigm selection has a profound impact upon the subsequent nature of the body of knowledge that is developed in any area of inquiry. Given the findings of this study demonstrated the dominance of a single paradigm this paper suggests that there is a strong case for ERP researchers to re-examine paradigm selection. In particular, to review how effectively this present paradigm selection helps or hinders to the development of the ERP body of knowledge, especially in respect to the issues of importance to managers within organizations (notably those concerned with social and change management issues). This research also identifies areas where existing paradigm evaluation methods could be enhanced and refined in respect to non-positivist classifications.

**Keywords:** ERP, research paradigms, epistemology, ontology.

**INTRODUCTION**

For over 20 years, information systems (IS) researchers (e.g. Orlikowski and Baroudi, 1991; Goles and Hirschheim, 2000; Mingers 2004; Chen and Hirschheim, 2004; Richardson and Robins, 2007) have engaged in a debate as to the importance of knowing what research paradigms were used when researching IS issues. In addition, researchers such as Orlikowski and Baroudi (1991) and Koch, Olsen and Tambo (2010) consider this debate to be important as it helps the discipline better understand the implications of paradigm selection in respect to theory development.

In this paper, we explore the question 'Where does enterprise resource planning (ERP) systems research sit in relation to the paradigms used by IS researchers in general?' The rationale for seeking to answer this overall research question is based on a view that ERP systems are sufficiently

distinctive to warrant being treated as a separate discipline in its own right rather than a subset of IS. If this suggestion is correct then it follows that ERP research may also differ in the usage rate of research paradigms employed compared to the rate found in the main IS literature. We took the view that it was important to determine if any differences existed, for the following reasons:

    i)   The selection of research paradigms has a profound impact on how a body of knowledge in a particular field will develop.

    ii)   If significant differences were found, these would provide secondary evidence to support the view that ERP systems do represent a distinct discipline, sufficient to warrant developing a separate body of knowledge rather than treating it as subset of the wider IS body of knowledge.

Factors which differentiate ERP from normal IS literature include a typical ERP implementation being not only the most costly information and communication technology (ICT) investment for an organisation, but also the most demanding in terms of the organisation-wide change management requirements it creates. Every individual who is connected to the ERP will, to varying degrees, have to be involved in workplace changes during implementation. These changes can vary from having to learn how to use the new system through to fundamentally changing work processes and practices in order to align with the new system's requirements. The scale of change generated by ERPs, would therefore suggest that this particular strand of IS research would be better disposed to the application of social science methodologies involving qualitative research paradigms

There is a body of opinion in the ERP literature which claims that ERPs are distinctly different from traditional IS in many dimensions, and particularly with respect to implementation issues (Robey, Ross and Boudreau, 2002; Morris and Venkatesh, 2010). These issues include business re-engineering; dependence on external consultants; high cost and disruption caused by widely reported failure rates; having to manage greater complexity as ERPs have been describes as "typically the largest, most complex and most demanding information systems implemented by firms" (Grabski, Leech and Schmidt, 2011, p.37); and very high costs. It is claimed that implementations can often represent the single largest item of organizational IS expenditure (Hawari and Heeks, 2010) where it is estimated between three and seven times more money is spent on ERP implementation and associated services compared to the initial purchase of the software license (Scheer and Habermann, 2000). Critically these issues, as reported, are clearly tied to a body of knowledge which in turn is influenced by the research paradigm used. Because a research paradigm carries with it several assumptions (e.g. about social structures) which in turn shape the knowledge used and the issues reported in the ERP literature, it is of great importance that ERP researchers fully understand the implications of their paradigm selection.

There is also a growing body of ERP literature that has highlighted the need to pay greater attention to social factors when considering research into ERPs (Nandhakumar, Rossi and Talvinen, 2005; Wood and Caldas, 2001; Markus, 1983; Orlikowski, 2000). We speculated, in our research questions, that if the differences between ERP and IS were sufficiently distinctive to warrant separating the two into different research categories, then this might also reflect the differences in extant research paradigm usage rates. Such differences, if proven to exist, would in turn reflect in the kinds of knowledge derived from research which, in turn, is used to inform practical concerns about ERP systems.

We were also eager to examine areas of similarity in the choice and usage rates of research paradigms. Most of the studies conducted in the generalised IS literature to determine the range of research paradigms employed have concluded that there is a strong bias toward positivism (Orlikowski and Baroudi, 1991; Hirschheim and Klein, 1992; Goles and Hirshheim, 2000; Mingers, 2004). However, despite the dominance of a single paradigm there is also evidence that the IS

literature has been expanding the range of research paradigms employed. For instance, Orlikowski and Baroudi's (1991) study claimed positivism accounted for 96.8% of studies.  Slightly over a decade later Chen and Hirschheim's (2004) study had reduced this figure to 81%.  Richardson and Robins (2007) contended that Chen and Hirschheim (2004) overestimated positivism and that a more exact figure was just below 50%.  This decline in positivism has been attributed to a recognition within IS to expand the research paradigms used in order to better understand critical social issues such as the role played by people (Chen and Hirschheim, 2004; Richardson and Robins, 2007). Because ERP literature had suggested a need to pay more attention to social factors, we assumed that investigating social factors would involve greater use of social science research paradigms which sit outside the positivist tradition.  As the social sciences often employ a diverse range of research paradigms (Jarvie, 2011) which also tend to change within short time periods (Baum and Rowley, 2002) then we speculated that the ERP literature would also be accompanied by an increase in diversity of the research paradigms used.

For all the aforementioned reasons, we were eager to conduct a basic comparison of research paradigm usage rates between ERP and IS, as suggested by our research question. Furthermore, given the raft of social issues associated with ERP implementations, we were curious to explore if ERP research tended to favour paradigms that were more aligned with the social rather than the natural sciences. In order to examine these matters in greater depth we conducted research designed to answer the following two questions. First, what types of research paradigms are employed in the ERP literature?  Second, are there any differences in the usage rates of research paradigms in ERP literature compared to mainstream Information Systems (IS) literature?

## BACKGROUND LITERATURE REVIEW

Several studies have been conducted in the generalised IS literature to determine the range of research paradigms employed. Most studies have suggested there is a strong bias toward positivism. (Orlikowski and Baroudi, 1991; Hirschheim and Klein, 1992; Goles and Hirshheim, 2000; Mingers, 2004).  Most of the major studies investigating the research paradigms used in IS literature have employed Chua's (1986) classification framework (Orlikowski and Baroudi,1991; Chen and Hirschheim, 2004; Richardson and Robins, 2007).

Chua's (1986) classification framework consisted of three possible research paradigms  A paradigm was defined by Chua as a community of scientists who share 'a constellation of beliefs, values, and techniques' and these beliefs 'circumscribe definitions of' worthwhile problems and acceptable scientific evidence' (Chua, 1986, p.602)  The three distinct research paradigms are positivist, interpretivist and critical studies.  Positivist studies are premised on the existence of *a priori* fixed relationships within phenomena which are typically investigated with structured instrumentation. Interpretive studies, by contrast, assume that people create and associate their own subjective and inter-subjective meanings as they interact with the world around them. Finally, critical studies seek to expose deep-seated structural contradictions within social systems and the use and abuse of power (Chua, 1986).

In the Orlikowski and Baroudi  (1991) study, their classification of positivism was in accordance with Chua's framework; however, they also classified certain descriptive studies as positivist.  Orlikowski and Baroudi (1991, p.5) defended this categorisation by stating that 'In "descriptive" work, researchers attempted no theoretical grounding or interpretation of the phenomena; rather, they presented what they believed to be straightforward "objective", "factual", accounts of events to illustrate some issue of interest to the information systems community'.   The criteria adopted by

Orlikowski and Baroudi (1991, p.5) to classify interpretive studies were 'evidence of a nondeterministic perspective where the intent of the research was to increase understanding of the phenomenon within cultural and contextual situations; where the phenomenon of interest was examined in its natural setting and from the perspective of the participants; and where researchers did not impose their outsiders' *a priori* understanding on the situation.' Classification of "critical" occurred where evidence was found of 'a critical stance towards taken-for-granted assumptions about organizations and information systems, and a dialectical analysis which attempted to reveal the historical, ideological, and contradictory nature of existing social practices' Orlikowski and Baroudi (1991, p.6).

Orlikowski and Baroudi (1991) reviewed 155 IS research articles from four sources in the period between 1983 and 1988. They found 96.8% of these research articles were positivist, 3.2% were interpretive and none was critical. In another study, Goles and Hirschheim (2000, p.254) concluded that 'Although the proportion of positivist to non-positivist articles varies somewhat from study to study, the indisputable consensus is that positivism dominates information systems research'. Chen and Hirschheim (2004) conducted a follow up study of Orlikowski and Baroudi's (1991) work, based on 1893 articles published between 1991 and 2001 and drawn from eight journals (four European and four US-based journals). Their study found that 'positivist research still dominates 81% of the published material' (Chen and Hirschheim, 2004, p.197). While using Chua's (1986) classification framework, they restricted their analysis to either positivist or interpretive paradigms, the rationale being that they concurred with the Orlikowski and Baroudi (1991) study, and its conclusion that there was a lack of interest shown in critical IS research.

 A third study conducted by Richardson and Robins (2007) challenged Chen and Hirschheim (2004) on three grounds. First, they claimed that the lack of interest in critical IS research (CISR) was restricted to higher ranked IS journals. They implied that higher ranked journals may exercise an institutional bias which systematically excludes CISR. Hence they concluded that CISR was the missing paradigm because 'the development of research taking a critical approach in IS has been represented in a number of the top publications on a very small scale between 1991 and 2001' (Richardson and Robins, 2007, p.264).

Second, they challenged the selection method used, claiming it resulted in an inflated figure. Their reasoning here was that the conclusion reached by Chen and Hirschheim (that 81% of the research was positivist) was based on a sample of 1131 (60%), while the original population was 1893. Richardson and Robins claim that it is not entirely clear why the other 40% were excluded but it is assumed that it was because they consisted of 'materials such as conceptual studies and other forms of research carried out without a guiding methodological framework' (Richardson and Robins, 2007, p.252). When Richardson and Robins adjusted Chen and Hirschheim's results relative to the total population (1893), the proportion of positivist categories dropped from 81% to 48.3%. The analysis undertaken by Richardson and Robins (2007) appears to be that if 40% were excluded on the grounds that they could not be classified, then they assumed they could be classified as non-positivist. As they did not explain how they determined that a sample which could not initially be classified under any heading could then be conclusively classified as non-positivist, it is difficult to comprehend the reasoning used to justify their conclusion about overestimation.

The third challenge was around interpretation of classifications. Richardson and Robins (2007) argued that Chen and Hirschheim's exclusion of the critical research paradigm was unjustified because of the claim that the number of studies using critical research had been increasing. To demonstrate the basis for this challenge, they examined 'a similar set of publications over the same time period (1991-2001) for papers which fall in the critical paradigm' (Richardson and Robins, 2007, p.254). Nine sources were used, including seven of the eight sources used in the Chen and

Hirschheim (2004) study. Richardson and Robins (2007) also used the Chua (1986) classification schema and they were able to identify a total of 31 articles that fell under the CISR category. However, without knowledge of the total sample it is not possible to say what percentage this figure represented. Similarly, no comment was made on the percentage occupied by the positivist and interpretivist paradigms. The conclusion offered was a wide range of concerns about the lack of CISR papers in highly ranked journals and suggested that 'Critical research is likely to remain the preference of a minority of IS researchers for the foreseeable future' (Richardson and Robins, 2007, p.265) and that the critical school should 'begin to develop its own voice' (Richardson and Robins, 2007, p.265).

The different results reached by the Chen and Hirschheim (2004) and Richardson and Robins (2007) studies highlight that variations in interpretation are problematic when it comes to paradigmatic categorization research. Despite Richardson and Robins making strenuous efforts to replicate the Chen and Hirschheim study by using similar data and the same classification scheme (namely, Chua, 1986) they reached very different conclusions. While it is unclear as to what caused these differences, it is widely acknowledged that all paradigmatic classification schemas tend to be open to a wide range of interpretations (Deetz, 1996; Chua, 1986; Willmott, 1993). A common criticism is "reification" – the tendency to mistake research abstractions for reality and producing biased and simplistic representations (Chia, 1995). Another is the tendency to change over time as 'The criteria for paradigm comparison and evaluation are essentially judgmental, open to change and grounded in social and historical practices' (Chua, 1986, p.606). Given the aforementioned limitations of classification schema the 'question is not: Are these the right categories or who fits in each? But: Are these differences that make a difference?' (Deetz, 1996, p.192).

## CLASSIFICATION FRAMEWORK DEVELOPED FOR THE RESEARCH

While a great deal has been written on the philosophy of science (for example – Okasha, 2002) and social science research (for example – Law and Lodge, 1984) far less seems to be available by way of practical tools which can be consistently applied for the purposes of classification. Burrell and Morgan's (1979) four sociological paradigm framework is the one of the earliest and most widely used of all such schema. However, it is now rarely used and has been challenged on several fronts, including its departure from Kuhn's original concept of paradigm, maintaining adherence to the incommensurability of paradigms view and reification of the dimensions used (Deetz, 1996; Lewis and Kelemen, 2002; Willmott, 1993). Chua's (1986) framework was developed for accounting research purposes, and despite its spread to IS, does not appear to have been widely adopted elsewhere. Johnson and Duberley (2000) are the latest to have developed a classification system of research paradigms. From an IS research perspective, their framework does appear to have some distinct advantages over previous categorization tools. It was developed specifically in the context of management research (which aligns well with ERP issues); it examined the criticisms of previous attempts including Burrell and Morgan (but not Chua); it matches almost identically with Chua's definition of positivism; and, importantly, appears superior to Chua's framework in that it provides a clearer delimitation of the absolute foundational elements of a paradigm, namely the epistemological and ontological stances taken.

Figure 1 below provides a graphic representation of the Johnson and Duberley schema (adapted from Johnson and Duberley, 2000, p.180)
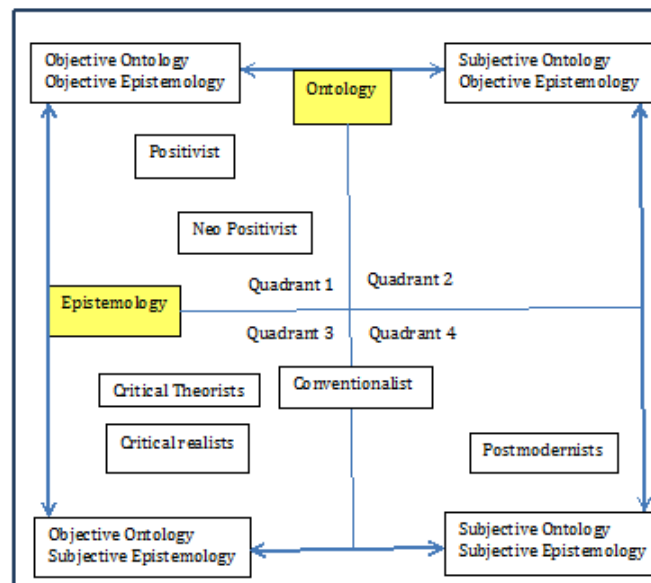


Figure 1. Johnson and Duberley schema

A key aspect of the above classification schema is that a research paradigm is determined by the possible combinations of ontology and epistemology as defined in either objective or subjective terms.   Johnson and Duberley (2000) call epistemology the finding of 'frameworks' of warranted scientific knowledge that acts as a guideline for representations of what knowledge claims can be made.   Ontology is defined by the same authors as the philosophy of being or what researchers think reality, being and existence are thought to be.   For example, a positivist ontology claims that reality is an objective set of causal laws (see Figure 1, Quadrant 1). A postmodernist conceives of reality as being dependent on the observers who create and sustain its meaning.  An objective stance implies that there is a reality that can be accurately assessed while the subjective position is far more sceptical about what researchers can determine to exist and what knowledge and truth claims they can make.

Classification of Quadrant 1, with an objective ontology and epistemology is defined as a positivist research paradigm.   No theory is given in Quadrant 2 as none exists which claims a subjective ontology and an objective epistemology. Quadrant 3, with an objective ontology and subjective epistemology covers many theories, but tends to be dominated by than those commencing with the adjective 'critical'.  The term 'critical' as described in Quadrant 3 therefore captures a wide range of theories including critical theory, critical realism and others.  Just what is meant by the term 'critical theory' is subject to many interpretations.  Richardson and Robinson (2007) and Sim and van Loon (2009) view critical theory as covering a wide range of epistemological and ontological positions which include poststructuralists such as Derrida (1973) and deconstructionists such as Belsey (2002). Johnson and Duberley's model, by contrast, makes it clear that there are very important ontological distinctions between critical theory and postmodernism.   These ontological and epistemological distinctions have profound implications for how research should be conducted and what truth claims can be made.  Therefore, Johnson and Duberley's model does not accept that the term should be so broad as to include theories which take entirely opposite ontological positions.  Under this model, a definition of critical theory is restricted to the original work of Marx, the Frankfurt School and

Habermas, or subsequent followers, which fit into an objective ontology and a subjective epistemology. Postmodernism is used to classify theorists such as Derrida, Baulrillard, Foucault and Lyotard who, according to Johnson and Duberley (2000), share a subjective ontology and epistemology,

Quadrant 4 refers to a research paradigm which assumes that both the ontological and epistemological stances are subjective, and is categorised as Postmodernism. Therefore, Johnson and Duberley define theorists such as Foucault and Derrida as Postmodernists in contradistinction to authors such as Richardson and Robinson (2007) and Sim and van Loon (2009) who would define these theorists as Critical Theorists. Another position illustrated in Figure 1, but not shown as a quadrant, is the rectangle entitled 'Conventionalists'. This term has been included because Johnson and Duberley claim that while many research approaches concede the difficulty of having either an objective ontology or epistemology, they are not prepared to embrace the postmodernist position. To do so would force them into accepting a relative position to all truth claims. Johnson and Duberley go on to claim that the seminal thinker on paradigms, Kuhn, was a conventionalist.

Because of difficulties associated with how to apply and interpret different classification schema, findings on the topic of which research paradigms are being used are open to challenge. It is unclear if variation in findings to date is due to differences in interpretation or in the actual data. This problem is unlikely to be resolved in the near future as Johnson and Duberley (2000, p.9) state 'In the epistemological literature we will find that there is considerable, and it would seem irresolvable, disagreement over epistemology and the standards by which we may discriminate warranted knowledge'.

## RESEARCH METHOD

The authors used the h-index to determine what IS journals were most highly cited from a list of highly ranked journals. The h-index (Hirsch 2005) has gained acceptance as a measure of the distribution of citations for both individual authors and journals with Mingers, Macri and Petrovici (2012, p.244) stating that 'the h-index is a better citation-based metric for measuring the research contribution of a journal than the impact factor'. The h-index was developed by Hirsch (2005) and is used to measure the productivity and impact of the published work of a scholar or a journal; it is based on cited papers and the number of citations that they have received; for example, an h-index of ten would mean that ten papers have each been cited ten times or more.

### h-Index Selection Process

The h-index for each journal was obtained using the software package Publish or Perish (Harzing, 2010) and analysis was conducted on the top two tiers (A* and A) of journal rankings from the Australian Council of Professors and Heads of Information Systems (ACPHIS 2010). The journal list and h-index for each journal is shown in appendix one. Due to resource constraints, the selection of journals was restricted to those with an h-index of over 100 and a timeframe from 2000 to 2010. A total of nine journals were selected, the details of which are shown in Table 1.

| Journal | h-index |
|---|---|
| Communications of the ACM | 292 |
| Harvard Business Review | 223 |
| MIS Quarterly | 183 |
| European Journal of Operational Research | 158 |
| Information Systems Research | 120 |
| California Management Review | 113 |
| Information and Management | 109 |
| Journal of Management Information Systems | 108 |
| Human-Computer Interaction | 104 |

Table 1 – List of h-index journals in descending order of ranking at the time of selection in 2011.

The rationale for selecting higher ranked journals was based on the assumption that the higher the ranking of the journal, the more likely it was that it would give emphasis to declaring its research stance. This in turn would make it easier to identify research paradigms. A potential limitation in selecting the h-Index is that it has been criticised on several grounds. For instance, that it can be manipulated. As this critique applies to all journal ranking systems, our selection of the h-Index was based on other criteria which suggested that, overall, it offered the most rigorous ranking system (e.g. refer Mingers et al., 2012). Another potential limitation is that there are discrepancies across the journals in terms of their research effort and emphasis given to ERPs. However, we concluded that to start making judgements as to what journals should be in or out based on our opinion would add more bias than staying within our original sampling design based on the h-Index. A final criticism is that poor articles can end up being highly ranked because they are subject to frequent criticism. We sought to reduce this risk by two means. First, the h-index was used to select journals rather than specific articles. Second, we took the view that because we only used articles drawn from the higher ranked journals the chance of introducing such a bias was further reduced. Third, the focus of the research was on research paradigms while criticisms of articles tend to be more around methodological issues and errors. Even if these articles were included in our sample the fact that their high rating was due to criticism would in itself ensure a sense of balance. Furthermore such articles still provided insights into the paradigms being used to generate or refute knowledge within the ERP literature and was therefore of interest to our study. For all of these reasons we were reasonably confident that the use of the h-index would not have an adverse impact on the overall aim of our study.

Each journal in the aforementioned list (Table 1) was searched issue by issue for articles that had ERP or Enterprise Resource Planning as part of either the keywords or abstract. To limit the search to the most recent research, we selected journal articles from the period 2000-2010. The rationale for this was that most of the work done in ERPs has taken place in the previous ten years. Secondly, given that this research represents a decade of progress, it is representative of the broad paradigmatic concerns and frames of references in the literature. This process yielded 90 articles. Selection from this population was further refined to include only those papers that consisted of either primary research or a detailed meta-analysis of other studies. Thirty-one articles which fell outside these selection criteria were excluded on the grounds that they were, for example, opinion pieces with no empirical or theoretical content or concerned with issues outside the scope of the study, such as capital investment decision. The remaining 58 articles used in the study were then classified against the criteria in Johnson and Duberley's framework.

## CLASSIFICATION FRAMEWORK

It could be conjectured that by not using the Chua model, we may have created difficulties for making a comparative analysis of the findings of our study with prior studies. However, we took the view that using the Johnson and Duberley model would help avoid the interpretation problems as exemplified by the differences in findings reached between the Richardson and Robinson (2007) and Chen and Hirschheim (2004) studies. It will be recalled that both teams of researchers used the same classification schemas and data yet reached different conclusions. While it was conceded that the introduction of a new classification framework would initially inhibit the ability to do comparative studies, the aspiration was that 'using a model which pays more attention to differences that make a difference' (Deetz, 1996, p.192) may go some way toward providing a tighter classifications schema which may in turn reduce some of the interpretation problems.

In addition, as this framework's definition of positivism is very similar to that used by most other classification schemas, and given that most literature to date has suggested that the positivist research paradigm dominates, then the use of the Johnson and Duberley framework would not inhibit comparative analysis for contrastive purposes.

The Orlikowski and Baroudi (1991) study highlighted that one area of potential definitional variations was associated with the concept of constructivism. Constructivism is 'an ontological position that asserts that social phenomena and their meanings are continually being accomplished by social actors. It implies that social phenomena are not only produced through social interaction but that they are in a constant state of revision' (Bryman, 2008, p. 19). Orlikowski and Baroudi (1991, p.15) highlighted that the 'difference between weak and strong constructionist positions has implications for how interpretative research relates to research conducted in the positivist mode'. However, Orlikowski and Baroudi were less forthcoming on how to map these distinctions back to their epistemological and ontological assumptions. This may in part be a reflection of a reticence to move beyond seeing critical theory as a very broad continuum. For the purposes of this research, a strong constructivist position was mapped back to the postmodernist position in Quadrant 4 of Figure 1. While a weak constructivist position accepts realism, it further divides into two types – positivist and a broader camp which includes critical theorists and critical realists. Weak constructivist positions were mapped back to either Quadrant 1 or Quadrant 3 on Table 2. A naïve positivist would reject a weak constructivist position; however most modern positivists would accept that weak constructivism is involved in most observations (Weber, 2004).

While Johnson and Duberley's (2000) taxonomy provides clear guidance on how to ultimately classify the data for the purposes of this research (at the paradigmatic level), the reality is that ERP researchers rarely define the philosophical research paradigm they employed. In such circumstances, we had to infer the paradigm from other information provided in the papers reviewed. In order to make clear the logic used for drawing such inferences and to also increase consistency in how individual researchers went about making inferences, a slightly modified version (we added ontology) of Crotty's (2004) research process diagram was used. Figure 2 provides a graphic outline of the ideal line of sight that should apply to the major elements involved in sound research.

| Weak Constructivists | Strong Constructivists |
|---|---|
| Quadrant 1 (Objective Ontology Objective Epistemology) Positivists believe in both realism (there is an external reality that is separate from our descriptions of it), and objectivism (an ontological position which assets that social phenomena and their meanings have an existence that is independent of social actors). Despite our tendency to impose weak constructions on observations, through the use of appropriate methods reality can be understood in an objective manner | Quadrant 2 in the (Subjective Ontology, Objective Epistemology) No advocates of this position exist |
| Quadrant 3 (Objective Ontology Subjective Epistemology) Critical theorists believe in realism but are cautious about objectivism arguing that conceptualisations provide a way of knowing reality rather than an objective representation of reality | Quadrant 4 (Subjective Ontology Subjective Epistemology) Post-Modernists – as social actors are always creating meanings; these meanings are antithetical to both types of realism maintained by weak constructivists. |

Table 2 – Weak and strong constructivist positions mapped to Johnson and Duberley's (2000) Paradigmatic Framework.
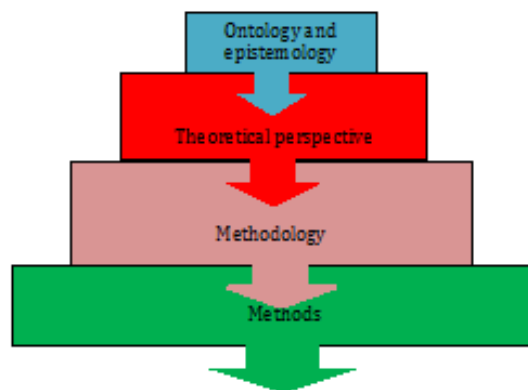


Figure 2 – Basic elements of the research process (adapted from Crotty (2004))

Definitions of the terms used in Figure 2 are as follows: Ontology, as mentioned previously, is concerned with the theory of being and, accordingly, addresses issues such as what entities exist or can be said to exist (Hartwig, 2007). Epistemology is the theory of knowledge and covers such topics as what we can know and how (Scruton, 2004). Crotty (2004) defines the theoretical perspective as the philosophical stance informing the methodology and thus providing a context for the research process and grounding its logic and criteria. Methodology is defined as the strategy, plan of action,

process or design lying behind the choice and use of methods for the desired outcomes. Methods are defined as the techniques or procedures used to gather and analyse data related to some research question or hypothesis.

For reasons that will be explained in more depth in the operationalization of this framework, at times we used all basic four levels of Crotty research process to initially interrogate the data. Despite this usage, it needs to be stressed that the unit of analysis for this study was the first level shown in Figure 2 (ontology and epistemology) and not the other levels.   While acknowledging that our research interest was on the knowledge creation process and that all four levels of the research process can exert an influence over knowledge creation, our study was strictly limited to the role that the research paradigm played in knowledge development. As Johnson and Duberley's (2000) framework defined paradigms in terms of the combinations of ontological and epistemological stances, for the purposes of answering our research question it followed that our final analysis had to be restricted to the first level of Crotty's research process.

## OPERATIONALIZATION OF THE FRAMEWORK

The research was operationalized by each article being read independently and assessed by two of the authors of this paper.  These readers first scanned articles at the highest level to see if ontological and epistemological positions were declared. If nothing definitive could be found at this level then the reviewers would move to the next level (Theoretical perspective), and so on, until they found some evidence that could be used to determine what research paradigm was being deployed. This approach assumed researchers would always strive for consistency across all four dimensions of Crotty's model such that there would be a coherent line of sight from the highest level to the lowest level of the research concept. Using this logic, it should be possible to draw inferences which could in turn be used to determine the research paradigm.

Several steps were taken to mitigate the risks associated with misclassification of research paradigms. To begin with, the first two readers re-read each article and checked for other contextual variables that may have been missed in the first reading.  Second, even if the individuals felt they could classify an article but had minor doubts, they flagged their concerns. Third, a comparison of individual results was compiled. Where there were disagreements, or agreements but minor concerns had been raised (by either or both reviewers) or if no classification was agreed to, then these articles were sent to the third reviewer for additional adjudication. Fourth, when individual researchers had any major concerns, they did not record a classification. This procedure ensured that the third reviewer would have to get involved in a group process with the other two reviewers in order to help resolve anomalies.

The use of this research approach has two limitations. The first is that the researchers in the papers we read may not have had, or even have wished to use, the clear line of sight that we used in our approach. The second is that the further down we had to go down on Crotty's adapted model (Figure 2) the greater the level of inference  involved and, therefore, the greater the risk of misclassifying the research paradigm.

## FINDINGS ON ERP LITERATURE

Table 3 summarizes the findings as mapped against Johnson and Duberley's (2000) framework, while Figure 3 is a graphical representation of the findings of paradigm usage scaled within that framework.

| Epistemology | Article Number[1] | Count | % |
|---|---|---|---|
| Positivist | 1-7, 9-24, 26-37, 39, 41-46, 48-58 | 53 | 91.4 % |
| Post-modernist (strong constructivist) | 8 | 1 | 1.7% |
| Critical Theory | 40 | 1 | 1.7% |
| Unclear[2] | 25,38,47 | 3 | 5.2% |

Table 3 Research paradigms used in ERP research

Positivist 92%

C S          U C          P M
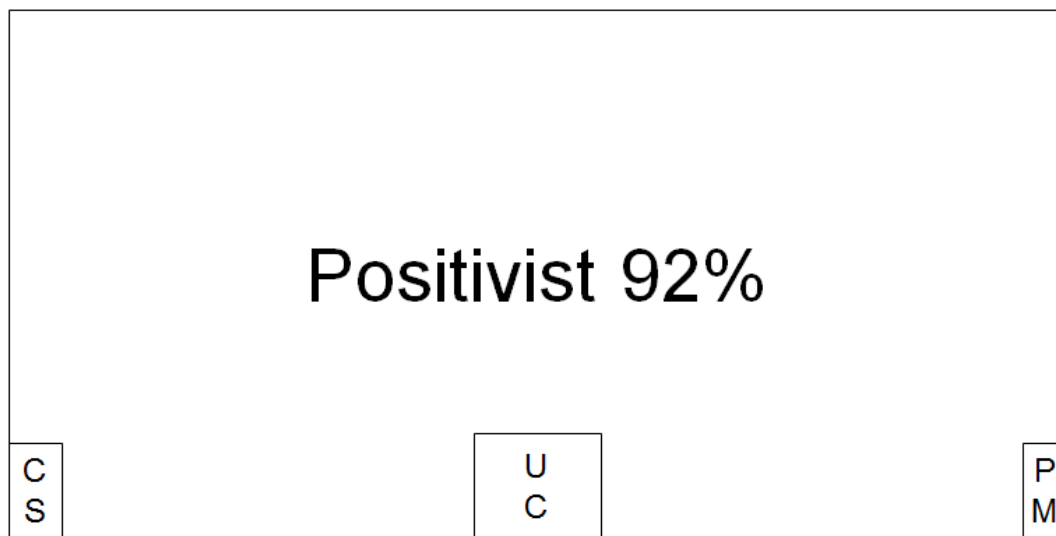
CS = Critical Studies (2%); PM = Postmodern (2%).
UC = Unclassified (6%)

Figure 3: Graphical representation of the findings of paradigm usage scaled within Johnson and Duberley's (2000) Framework.

Note - This Figure has deliberately been drawn large in order to clearly display the ratios between each approach and thereby graphically illustrate the finding as to the dominance of a single paradigm in ERP research.

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[1] Please refer to appendix two for article numbers.
[2] This includes both articles that were not able to be classified and those where the two reviewers could not agree on an epistemology.

## DISCUSSION

The results of this study fall between the Orlikowski and Baroudi (1991) study's finding of 96.8% and the Chen and Hirschheim (2004) study's findings of 81%. However, if we exclude the unclear results (as did both Orlikowski and Baroudi, and Chen and Hirschheim), then the percentage of positivist research rises to 96.6% and this is identical to the  Orlikowski and Baroudi  study conducted over twenty years ago.  For the reasons already outlined, the differences in classification schema and interpretation make comparisons of non-positivist paradigms difficult. These overall findings are generally in line with several other studies and commentaries, such as those by Orlikowski and Baroudi (1991), Goles and Hirshheim (2000), Mingers (2004) and Chen and Hirschheim (2004), which claim that positivism dominates IS literature. The findings of our study strongly suggest that the choice of research paradigms used in ERP literature is similar to that found in the wider contemporary IS literature (albeit slightly more biased towards positivism).

It will be recalled that Richardson and Robins (2007) used the same data and classification but different sampling methods to those of Chen and Hirschheim (2004).  Richardson and Robins (2007) concluded that the figure of 81% was grossly inflated; when adjusted for the total, the figure fell to 48.3%.  However, just as these authors were correct to highlight why the 81% was an inflated figure, we would argue they have, in turn, underestimated the percentage of positivist articles.   While using Richardson and Robins's (2007) classification of the primary data used in this study would deflate the dominance of positivism, it would not undermine the overall conclusion that ERP literature employs research paradigms with a higher positivism bias than would be found in the wider IS literature. Furthermore, irrespective of which of the two sampling methods is applied to this study, positivism dominates (91.4%, if we declare the unclear articles as non-positivist, or 96% if we exclude them).

The three papers we could not classify fell under the heading of weak constructivist.  The difficulty was in deciding if they should be deemed positivist or critical, or both, as they could easily be classified as being multi-paradigmatic.  Our study did not initially consider multi-paradigmatic approaches.  However, as far back as 2000, Goles and Hirshheim analysed other studies (notably Orlikowski and Baroudi, 1991 and Walsham, 1995) and concluded that while IS studies were heavily guided by the positivist paradigm, they advocated the need to end the 'paradigm wars' and  move instead to a stance based on paradigmatic pluralism. Other authors such as Mingers (2004) and Lewis and Kelman (2002) have advocated similar stances.  Future studies would need to consider how to classify multi-paradigmatic stances. While none of the studies that used Chua's (1986) model explained the criteria used to exclude articles, if they used logic similar to that used in our study, then it would suggest to us that many of these excluded articles may be positivist.  We therefore have reservations about Richardson and Robinson's claims as to an overestimation of positivism. Just because there is not enough information to classify an article as positivist, it doesn't follow that it automatically becomes non-positivist.

Although this study used a different classification schema to that employed by other studies, the findings did align with the interpretation applied by Chen and Hirschheim (2004) and Orlikowski and Baroudi (1991).  Variations in interpretation will remain a difficulty with these types of studies until a more stable and widely agreed classification schema is accepted. Therefore, developing a more rigorous and widely accepted classification schema for categorising paradigms would be a worthwhile enterprise in order to improve the usefulness of future research in terms of making meaningful trend comparisons.  We consider our study using the Johnson and Duberley (2000) framework to be a useful start in that direction.

The overwhelming bias towards positivism in the ERP domain suggests that the increasing interest in social factors associated with ERP implementations has not been accompanied by changes in the

research paradigms used. While this study did not track paradigmatic changes over time in the ERP literature, the wider IS literature does suggest a remarkably stable pattern in respect to the dominance of positivism over the past decade. Given this trend, and the strong alignment of IS and ERP on research paradigms, it would appear reasonable to imply that what is happening in both bodies of literature is similar.

While there are many possible explanations for why ERP literature maintains a higher rate of positivism than the wider IS literature, there are two that appear to be worthy of investigation. The first is that ERPs are in some sort of lag mode relationship to IS, possibly due to factors such as having little flexibility. The second is that while some researchers (Robey, Ross and Boudreau, 2002; Morris and Venkatesh, 2010) have claimed that the differences between ERPs and IS may be significant (especially in social terms), consistent with the claims of positivism, both can still be researched under the one paradigm. Indeed, positivism's claim of strength is that it can be applied to all forms of research. However, there are many other plausible explanations and there is a need for further research before any strong conclusions can be drawn.

The contribution of our paper has been to establish the ratio of research paradigms used in the selected ERP literature. This has helped inform what ERP's paradigmatic stance is, relative to the paradigmatic debate. The findings of our study give rise to the question: Is the dominance of a single research paradigm in the ERP literature important? As there is already a vast body of IS literature which argues that it is (Orlikowski and Baroudi, 1991; Richardson and Robins 2007), we accept that this is most likely the case. It is our hope that having demonstrated that ERP literature is dominated by a single research paradigm, other researchers will use our findings to explore what implications, if any, follow from continuing to develop a body of knowledge overwhelmingly within a positivist paradigm. If Richardson and Robinson (2004) are correct in their claim of institutional bias in higher ranked journals, then the sample of journals with an h-index of over 100 that we used may simply be reflecting a bias. Until this claim is investigated in depth, the strength of the findings in this study can be easily challenged. Future research in this area should include a larger cross-section of journals and, as suggested by Richardson and Robinson (2004), may include lesser-ranked journals.

## CONCLUSIONS

This research set out to determine the types of research paradigms employed in ERP literature. The intent of our meta-level analysis of the paradigms used was descriptive, with no intent to offer a detailed prescription of research methodologies and tools which could be used within each paradigm. Our descriptive findings led us to draw the conclusion that the ERP literature is in lag compared to the wider IS literature. In the last thirty years of IS literature, the first two decades were dominated by positivism. In the last decade, however, there has been a widening of the paradigms used. Our findings show that a similar broadening is not reflected in the ERP literature. In fact, the rate of usage of the positivist paradigm in the ERP literature is almost identical to that found in the general IS literature of the first two decades. This difference between the ERP and IS literature is made all the more stark when it is recalled that the sample used for the ERP literature was drawn from 2000 to 2010. If the wider IS literature has found its way to a broadening of research paradigms used in order to enhance theory development, it begs the question of why this is not similarly reflected in ERP literature. This findings seems all the remarkable given the previously mentioned call for more socially aware research into ERP implementations There would appear to be, therefore, good grounds to justify ERP researchers engaging more fully in this debate on paradigm usage. Such an engagement would help determine if ERP activities are sufficiently different from general IS activities to warrant the development of its own body of knowledge or if it should simply be subsumed under existing IS theories.

This study has two main limitations. The first is that the data gathered was limited to those journals with an h-index of 100 or over and this may be a biased sample. This limitation can be overcome with wider sampling. The second limitation has to do with interpretation and is not so easily resolved. As shown, there are many ways to interpret research paradigms and this task is not made any easier by the common practice of using the same terms to mean vastly different concepts. Developing a more robust classification scheme would therefore be a useful development in helping improve the process for conducting comparative studies into the paradigms being used in IS and ERP research.

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Appendix 1 – A and A* journal list from ACPHIS with h-index derived from Publish or Perish

| Journal | ACPHIS rank | h-index |
|---|---|---|
| Decision Support Systems | A* | 85 |
| European Journal of Information Systems | A* | 62 |
| Information and Management | A* | 109 |
| Information Systems Journal | A* | 80 |
| Information Systems Research | A* | 120 |
| Journal of Information Technology | A* | 86 |
| Journal of Management Information Systems | A* | 108 |
| Journal of the Association for Information Systems | A* | 68 |
| MIS Quarterly | A* | 183 |
| Behaviour and Information Technology | A | 63 |
| California Management Review | A | 113 |
| Communications of the ACM | A | 292 |
| Communications of the Association for Information Systems | A | 88 |
| Data and Knowledge Engineering | A | 68 |
| DATA BASE for Advances in Information Systems | A | 11 |
| Electronic Commerce Research | A | 39 |
| Electronic Markets | A | 43 |
| European Journal of Operational Research | A | 158 |
| Harvard Business Review | A | 223 |
| Human-Computer Interaction | A | 104 |
| IBM Systems Journal | A | 96 |
| Information and Organization | A | 38 |
| Information and Software Technology | A | 59 |
| Information Systems | A | 96 |
| Information Systems Frontiers | A | 33 |
| Information Technology and People | A | 47 |
| International Journal of Electronic Commerce | A | 59 |
| International Journal of Forecasting | A | 45 |
| International Journal of Medical Informatics | A | 58 |
| Internet Research: Electronic Networking, Applications and Policy | A | 53 |
| Journal of Behavioral Decision Making | A | 59 |
| Journal of Computer Information Systems | A | 29 |
| Journal of Global Information Management | A | 58 |
| Journal of Information Systems | A | 61 |
| Journal of Organizational Computing and Electronic Commerce | A | 40 |
| Journal of Strategic Information Systems | A | 54 |
| MISQ Executive | A | 6 |
| MIT Sloan Management Review | A | 60 |
| OMEGA | A | 86 |
| Scandinavian Journal of Information Systems | A | 28 |

Appendix 2 – Analysed papers

1. Soh, C., Kien, S.S. and Tay-Yap, J. (2000). Cultural Fits and Misfits:is ERP a Universal Solution?  Communications of the ACM, Vol. 43, No. 4, pp. 47-51

2. Willcocks, L.P. and Sykes, R. (2000). The Role of the CIO and IT function in ERP. Communications of the ACM, Vol. 43, No. 4, pp. 32-48

3. van Everdingen, Y., van Hillegersberg, J. and Waarts, E. (2000). ERP adoption  by European midsize companies: Searching for ERP systems offering a perfect fit. Communications of the ACM, Vol. 43, No. 4, pp. 27-31

4. Markus, M.L., Tanis, C and van Fenema, P.C.  (2000). Multisite ERP Implementations. Communications of the ACM, Vol. 43, No. 4, pp. 42-46

5. Kumar, K and van Hillegersberg, J. (2000). ERP Experiences and Evolution. Communications of the ACM, Vol. 43, No. 4, pp. 22-26

6. Sprott, D. (2000). Componentizing The Enterprise Application Packages  Communications of the ACM, Vol. 43, No. 4, pp. 63-69

7. Kumar, K. (2001). Technology for supporting supply chain management. Communications of the ACM, Vol. 44, No. 6, pp. 58-61

8. Davison, R. (2002). Cultural Complications of ERP.  Communications of the ACM, Vol. 45, No. 7, pp. 58-61

9. Lee, J., Siau, K. and Hong, S (2003). Enterprise Integration with ERP and EAI. Communications of the ACM, Vol. 46, No. 2, pp.54-60

10. Arinze, B. andAnandarajan, M. (2003). A Framework for Using OO Mapping Methods to Rapidly Configure ERP Systems.  Communications of the ACM, Vol. 46, No. 2, pp.61-65

11. Liang, H., Xue,Y., Boulton, W.R. and Byrd, T.A. (2004). Why Western Vendors Don't Dominate China's ERP Market: Examining cases of failed ERP system implementation in China and explaining the unique circumstances.  Communications of the ACM, Vol. 47, No. 7, pp. 69-72

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13. Shore, B. (2006). Enterprise IN across the Globally Disbursed Service Organization. Communications of the ACM, Vol. 49, No. 6, pp102-106

14. Morris, G. and Venkatesh, V. (2010). Job Characteristics and Job Satisfaction: Understanding the Role of Enterprise Resource Planning System Implementation.   MIS Quarterly Vol. 34 No. 1, pp. 143-161

15. Ko, D-G., Kirsch, L.J., and King W. R. (2005). Antecedents of Knowledge Transfer from Consultants to Clients in Enterprise System Implementations.  MIS Quarterly Vol. 29 No. 1. pp. 59-85

16. Gattiker, T.F and Goodhue, D.L (2005). What happens after ERP implementation: Understanding the impact of interdependence and differentiation on plant-level outcomes. MIS Quarterly Vol. 29 No. 3, pp. 559-585

17. Cotteleer, M.J. & Bendoly, E. (2006). Order lead-time improvement following Enterprise information technology implementation: an empirical study,  MIS Quarterly Vol. 30 No. 3, pp. 643-660

18. Karimi, J., Somers, T.M. and Bhattacherjee, A (2007). The Role of Information Systems Resources in ERP Capability Building and Business Process Outcomes.  Journal of Management Information Systems, Vol. 24, No. 2, pp. 221–260

19. Karimi, J., Somers, T.M. and Bhattacherjee, A (2007). The Impact of ERP Implementation on Business Process Outcomes:A Factor-Based Study.  Journal of Management Information Systems, Vol. 24, No. 1, pp. 101–134

20. Kauffman, R.J and Tsai, J.Y. (2009). The Unified Procurement Strategy for Enterprise Software: A Test of the "Move to the Middle" Hypothesis. Journal of Management Information Systems Vol. 26, No. 2, pp. 177–204

21. Seddon, P.B., Calvert, C. and Yang, S. (2010). A multi-project model of key factors affecting organizational benefits from enterprise systems. MIS Quarterly, Vol. 34, No. 2 pp. 305-328

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37. Romero, J.A., Menon N., Banker R.D, and Anderson M. (2010). ERP: Drilling for Profit in the Oil and Gas Industry: Communications of the ACM Vol. 53 No. 7 pp. 118-121

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