



## **International Journal of Educational Management**

### **Emerald Article: Costs and benefits of the workaround: inventive solution or costly alternative**

Lisa A. Petrides, Sara I. McClelland, Thad R. Nodine

#### **Article information:**

To cite this document: Lisa A. Petrides, Sara I. McClelland, Thad R. Nodine, (2004), "Costs and benefits of the workaround: inventive solution or costly alternative", International Journal of Educational Management, Vol. 18 Iss: 2 pp. 100 - 108

Permanent link to this document:

<http://dx.doi.org/10.1108/09513540410522234>

Downloaded on: 05-12-2012

References: This document contains references to 19 other documents

Citations: This document has been cited by 4 other documents

To copy this document: [permissions@emeraldinsight.com](mailto:permissions@emeraldinsight.com)

This document has been downloaded 335 times since 2005. \*

Access to this document was granted through an Emerald subscription provided by UNIVERSITY OF MICHIGAN

#### **For Authors:**

If you would like to write for this, or any other Emerald publication, then please use our Emerald for Authors service. Information about how to choose which publication to write for and submission guidelines are available for all. Please visit [www.emeraldinsight.com/authors](http://www.emeraldinsight.com/authors) for more information.

#### **About Emerald [www.emeraldinsight.com](http://www.emeraldinsight.com)**

With over forty years' experience, Emerald Group Publishing is a leading independent publisher of global research with impact in business, society, public policy and education. In total, Emerald publishes over 275 journals and more than 130 book series, as well as an extensive range of online products and services. Emerald is both COUNTER 3 and TRANSFER compliant. The organization is a partner of the Committee on Publication Ethics (COPE) and also works with Portico and the LOCKSS initiative for digital archive preservation.

\*Related content and download information correct at time of download.

---

# Costs and benefits of the workaround: inventive solution or costly alternative

---

Lisa A. Petrides  
Sara I. McClelland and  
Thad R. Nodine

---

## The authors

Lisa A. Petrides, Sara I. McClelland and Thad R. Nodine are based at the Institute for the Study of Knowledge Management in Education, California, USA.

---

## Keywords

Higher education, Management accountability, Information management

---

## Abstract

In the current climate of increased accountability in higher education, many colleges and universities are considering ways to improve their collection and analysis of data and information to achieve organizational improvement. While there has been much written about the costs, difficulties, and challenges of implementing new information systems on college campuses, the costs and benefits of maintaining current systems are not well understood. Our research suggests that in a challenging information environment, enterprising individuals – when unable to obtain the data they need from existing information systems – compensate by creating, or participating in, idiosyncratic methods of data collection and management. These informal practices – called *workarounds* – can be seen as both inventive solutions to pressing organizational needs and over time, and costly alternative to a robust and flexible information system.

---

## Electronic access

The Emerald Research Register for this journal is available at  
[www.emeraldinsight.com/researchregister](http://www.emeraldinsight.com/researchregister)

The current issue and full text archive of this journal is available at  
[www.emeraldinsight.com/0951-354X.htm](http://www.emeraldinsight.com/0951-354X.htm)

## Introduction

Over the past two decades, as the accountability movement has spread across the country, there has been a growing need for first K-12 and currently higher education institutions to track and analyze information in such areas as student services, enrollment management, and student outcomes (Wells *et al.*, 1999). This increasing climate of accountability can be seen in the prevalence of performance-based funding mechanisms used by state legislatures, as well as in revised methods and goals of accrediting agencies (Burke and Minassians, 2001; WASC, 2002). Meanwhile, colleges and universities have been working on their own to find out more about the effectiveness of their programs and services in meeting the needs of their students. In some cases, these internal efforts for better tracking and use of information have been led by governing boards and upper management; in other cases, they have been guided and shaped by the persistence of faculty and staff leaders.

While the costs, difficulties, and challenges of implementing new information technology (IT) systems on college campuses have been well documented, there is less written about the costs and benefits of maintaining insufficient technological systems and the subsequent information practices and patterns that ensue. Our research in a community college district suggests that in an insufficient information environment, enterprising individuals who are unable to obtain the data they need from the existing IT system, or from other formal campus processes, compensate by creating or participating in idiosyncratic methods of data collection or management. These informal practices – called *workarounds* – can include low-tech solutions, such as hand counting the number of student interventions on a given day each week to establish patterns of use, or reviewing a selected number of student transcripts by hand to determine the effectiveness of a program. Workarounds can also include more sophisticated technological solutions, such as the designing of local, non-official databases and information systems

---

This research was supported in its entirety by a grant from the Atlantic Philanthropies, to whom the authors express appreciation for their support and assistance.



that are able to provide or disaggregate data in ways that the district-wide information systems cannot. This might also include exporting data from official campus-based systems to alternative software programs that allow for more robust analysis or increased access.

## Literature

An increased interest in measuring student outcomes and institutional effectiveness has placed greater burdens on internal research efforts at colleges and universities. There are pressures to track and compile more robust information, understand its context, and use it in decision-making for program and service improvement. A vibrant technological infrastructure plays a key role in helping an educational institution to gather and analyze information to improve results (Oblinger and Rush, 1997). In fact, studies have shown that it is often easier to persuade organizations to acquire new technology tools than to modify or redesign the existing organizational processes (Coate, 1996). However, numerous studies have also shown that technology tools alone do not address issues of discordant organizational information structures (Petrides, 2002; Sirotnik and Burstein, 1987; Telem, 1996). In fact, many failed implementations of information systems in higher education have been attributed to issues related to organizational culture – organizational processes and practices, information politics, patterns of information sharing and hoarding, and the like – rather than technological capabilities (Davenport, 1997; Friedman and Hoffman, 2001; Levine, 2001).

Existing literature on workarounds builds from an understanding of existing practices and attitudes within the organization, showing that human action is a fundamental component of investigations of technology use (Hayes, 2000; Jones, 2000). It suggests that actual use of technology often deviates from formally instituted procedures, and that the informal practices of workarounds may be much more commonplace than previously thought (Ciborra, 1996; Grudin, 1990; Moran and Anderson, 1990). Because the focus of prior research has been primarily on corporate and other business settings, yet it has to adequately

address the specific context of educational institutions.

Our study builds on the existing research on workarounds by illuminating the specific circumstances and pressures of higher education. It suggests that within colleges and universities, workarounds can be seen as inventive and short-term solutions to pressing organizational needs. Over time, however, failure to invest in a robust and accessible information system can promote the calcification of workarounds, with significant costs to the organization in terms of such things as staff time and lost opportunities. Fortunately, existing workarounds within an organization offer a blueprint for identifying the pressing information gaps that need to be resolved when considering improvements in information flow, and who needs to be on board in moving forward to improve the use of information on campus.

## Methodology

The research site was a multi-campus community college district in California. From the outset of this research, we were interested in discovering the processes that people used to obtain data and information that were necessary in order to respond to the needs of the educational institution. A combination of both qualitative and quantitative research methods was used. This included 49 in-depth interviews with a non-random sample of administrators, faculty, and staff who represented a cross section of those involved at various levels of organizational decision-making. We also conducted a survey of administrators, staff and faculty about their use of data and information.

In the qualitative interviews, we asked participants to recall specific incidents in which they required data for a specific decision, the context of those incidents, and whether the incident had a successful or unsuccessful outcome. This enabled us to take a snapshot of what types of data or information had been requested over the past year and, most importantly, to identify the processes undertaken by information seekers to obtain the data they needed. We used the critical incident technique to elicit examples and outcomes about actual behaviors that relied upon specific

recall, thereby bypassing opinions and hypothetical situations (Flanagan, 1954). This technique is used predominantly when studying human systems, tasks, and organizations.

The interview data were collected and transcribed, and a set of comprehensive codes was developed that allowed the data to be broken into smaller components and then analyzed for reoccurring themes. We used a qualitative data analysis software tool that allows the data to be easily coded and searched. This enabled us to associate codes with pieces of text, to search these codes for patterns, and finally, to construct classifications of codes that reflect the conceptual structure of the underlying data.

A survey that looked at the use of data for decision-making was administered to 1,194 full-time administrators, staff and faculty with an overall response rate of 19 percent. Over a 3 months period, the survey was sent and three follow-ups took place that included a postcard sent in the mail, an e-mail reminder and a random sampling of phone calling to encourage survey completion. The analyses in this paper are based on a subset of variables drawn from a survey that included specific questions about whether and how the participant had gathered and analyzed data on his/her own, separate from the use of the district-wide information system. Specifically, we looked at the survey items that asked the participant what data were collected and analyzed, how many hours per month this task required, why the participant need to collect the data, and how the data were collected.

### **Satisfying an unmet need for data**

Community colleges have an internal need for data to support the review of programs and services, as well as a growing need to gather and report data to external agencies. Internally, community colleges need data to inform decision-making on issues such as enrollment management, faculty hiring, faculty load, resource allocation, annual budgets, and scheduling. Externally, administrators need data for state and federal reporting on a wide range of issues as well, such as performance

funding, financial aid, and other compliance-related matters.

At this site, individuals who needed access to data located within district-wide information systems could either retrieve data directly from the systems, or they could make a request directly to the two-person office of institutional research. The technological infrastructure consisted of a legacy system that was comprised of a series of flat, non-relational databases. An assortment of software applications for data translation, access, and reporting had been directly available to the users of the data. However, for non-technical administrators, staff, and faculty, accessing data from district-wide information systems was reported to be time-consuming and cumbersome and required a high level of technical expertise that many people did not have. Because there were several different software applications that could be used for data access, extraction, and reporting, it was difficult to make comparisons of data. This fueled the perception that the data were not generally accurate or complete. Also, because of the limitations of the non-relational databases, much of the disaggregated data needed for long-term comparisons was difficult if not impossible to obtain by the average user.

For example, several interview participants reported that they often felt left in the dark after unsuccessful attempts to access the district-wide information systems themselves. One participant said:

Whether or not that's an accurate number, or whether that's the number of people who enrolled at the beginning or the number that are left, I have no clue.

In response to their own inability to obtain or access data from the district-wide information systems, several participants reportedly sought out their own local, alternative ways to gather or analyze data. These workarounds included manipulating the available data, finding new ways to generate and gather data themselves, or using alternative technologies. One participant said:

I've been able to gather what I need at a point in time when I need it, to a certain extent. I'm sure there's a lot more that I would love to have. But it's not available. So you sort of make due with what you have. I think that's sort of an attitude too. You just make do with what you have; you work around it.

## Evidence of workarounds

The survey, which included specific questions about whether or not the respondents had gathered information on their own, outside of the formal district-wide information system, provided an in-depth picture of the prevalence of workarounds at the research site. For instance, the survey asked respondents what data they collected and/or analyzed, how many hours per month the task required, why they need to collect the data, and how the data were collected. In analyzing the survey results, we grouped the localized informal efforts of data gathering and analysis, otherwise known as “work arounds”, into two categories. The first category was classified as “essential” workarounds, meaning that these were workarounds for data that the district-wide information already contained, but for whatever reason, were not obtained through the formal channels. This category was coded to include those efforts in which data could or should have been available to users if the system itself had been more robust, functional, accessible, etc., and specifically for data essential or required for basic state reporting, program review, etc. This might include demographic information about students, class rosters for faculty, student placement test scores, and downloadable names and addresses for mailings.

The second category, “ancillary”, was used for those workarounds that were comprised of efforts to collect data that were secondary or non-vital to the everyday processes required for state and other agency reporting. The bulk of these responses represented efforts by program faculty and staff to gather and analyze student survey information, efforts that were unique to program objectives and less appropriate for placement within the district-wide information system. Table I describes the two categories.

Of the 222 survey respondents, a total of 54 percent ( $n = 120$ ) participated in localized workaround efforts. Of the 54 percent of the survey respondents who collected workaround data, 49 percent ( $n = 59$ ) participated in “essential” data collection workarounds, and 51 percent ( $n = 61$ ) participated in “ancillary” workarounds. No particular group – administrators, faculty, or staff – relied on workarounds any more than others [1].

Table II shows that the majority of essential workarounds required ten or less hours per month of the respondent’s time. Approximately 50 percent of those who collected “ancillary” workaround data reported spending less than 3 h per month. This may mean that what we have described as “ancillary workarounds” are indeed smaller-scaled tasks that are relatively easy to handle and do not require much time. On the other hand, essential workarounds seem to require more hours per month on the part of the individual.

From the interview data, we found that of the 49 administrators, faculty, and staff who were interviewed, 29 percent ( $n = 14$ ) of the participants reported that they regularly take part in informal, localized data tracking and analysis to perform their job responsibilities. It is important to note that the protocol for these interviews did not include a specific question focusing on workarounds. Rather, the existence of the workarounds came up in these interviews in response to questions about how they used data and information for decision-making.

## The hidden costs of the workaround

While the survey data indicate that workarounds are not an uncommon phenomenon throughout the organization, interview data provided a rich understanding of the extent of their use. The interview data reveal that there are significant costs to the regular use of workarounds, most of which are hidden and are not considered in overall cost assessments of information technology use. In most cases, employees who had to “workaround” the existing technological and information gaps were very aware of the excessive amount of time and resources they expended to gather and analyze the data they needed to perform their jobs. This district-wide information system’s challenging infrastructure had created situations in which people got used to spend time on the same kind of routine tasks, year after year. For example, many participants described elaborate processes that they used to manually gather data, physically delving into day-to-day operations of programs and departments. One participant explained:

**Table I** Types of tasks associated with essential and ancillary workarounds

Essential workarounds	Ancillary workarounds
Determining the costs of running a specific program	Determining scoring of pre- and post-tests for a specific program
Gathering information about student retention rates	Administering student satisfaction surveys for a program
Gathering information about student demographics	Obtaining testimonials from students about a program
Obtaining a list of students enrolled in a specific program	Comparing local staffing ratios to other districts
Comparing teaching outcomes among institutional assistants	Administering student questionnaires on first day of class to determine student needs
Determining success and persistence rates associated with curricular revisions	Filling out enrollment forms for special programs
Downloading names and addresses for mailing	Hiring a consultant to perform a campus-wide transportation survey to assess transportation habits of students, faculty, and staff
Gathering information for statistical reports to county, state, and federal agencies	Determining scoring of pre- and post-tests for a specific program
Scheduling student appointments	–
Tracking applicant information	–
Collecting follow-up job related data concerning students who have completed programs	–

**Table II** Time spent on essential versus ancillary workarounds

Hours spent per month	Essential workarounds	Ancillary workarounds
Less than 3 h	12	24
3-5.5 h	13	8
6-10 h	10	8
11-20 h	8	7
Over 20 h	8	4
Subtotal	51	51
Hours left blank	8	10
Total	59	61

I take care of it myself. I manually track my students. I have gone so far as to look at the students program by program.

Many participants reported that they felt it necessary to perform manual counts to verify the accuracy of data. For instance, one participant explained that she had trouble in obtaining accurate enrollment numbers, which were crucial because they determined class offerings, class size, and had fiscal ramifications. Because of the need for timely

and accurate data in this situation, this participant verified her numbers by going directly to the classroom:

We went over there to observe and say, “Excuse me, do you really have this many people?” Physically – that’s how we have to do everything. So it’s a physical reconnoiter to make sure that that’s really what it was.

Participants reported the routine creation and use of local workaround databases that had been created because individuals had not found any

other way to access the data they needed. One participant explained:

And over time, we've been learning what data we need that we can never get, so we're starting to ask people to keep their own set-up.

Another participant explained how he took time to manually negotiate the conversion of data from the district-wide system into his own information systems so that he could manipulate the data in ways that were more useful to him. When asked how long it took to perform this activity, he explained:

An awful lot of time, a couple of hours every day, to just massage the data and produce an updated spreadsheet. I do that on a regular basis for a couple of weeks – a week before and even a week after classes begin. Then things become stabilized and then we shelf that and start all over again at the end of the quarter.

These databases, which were located throughout the institution, typically consisted of data that had been compiled over several years, though often in inconsistent ways. They required considerable staff time to create and maintain, and the results were considered useful, but not necessarily complete or accurate. One participant said:

I call people up and I say, "Okay, do you have any idea how many certificates you gave last year?" [And they say] "Oh I got to, well let's see." They plow through whatever they have with little pen scratchings on it, and I get a rough idea. Is this data I would bet my life on? No way in heck, no way. And because nobody has any data, a lot of folks keep their own stuff. So we're getting their own record, as best as they've kept it. Which is not accurate, but it's better than nothing.

In this case, the program head is fully aware of the extensive staff time that is required for manual data gathering and the creation of separate databases. He is also fully aware that the results are not necessarily accurate.

Nonetheless, because he has no other way to obtain the information he needs, he encourages people to perform these kinds of routine and repetitive tasks that information systems are designed to perform regularly.

Participants also reported that they routinely spent inordinate amounts of time in manipulating or rekeying data that had already been gathered by the central system so that they could make it available for their own needs. For instance, one participant described a process

used throughout the college to rekey data already available through – but not usable by – the central system:

The instructors all have their own spreadsheets for the class lists. They can't get it from the school – they have to input it by hand, even though a computer has this. The class list is generated by a computer, but they can't import it into their computer, so they do this by hand. They input their own set-up. They print out a copy and highlight it. [The assistant] pulls up the person, goes to the screen where it gets their address, and writes it down so that she can make me address labels. So it's manual. There's no way to do anything on this computer system except look at stuff and write it down.

The creation and maintenance of local databases represent other hidden costs as well to the organization. For instance, we found that the existence and prevalence of local databases served to further fragment the data environment at this community college by creating information silos. Rather than having common, formalized procedures to obtain information, individuals had to know whom to approach to access the data they needed.

Second, we found many instances in which the databases outgrew the skill levels of their creators. In general, individuals who created local databases were technically savvy, in that they knew how to use a particular software program to create, maintain, and manipulate a database. But because these databases often used software that was not supported by the institution, some participants reported being confronted by their own inability to use their software to its full capacity.

Third, we found that this problem was compounded when the originator of the database left the organization. In many cases, the college lost not only the database entirely, but also the findings or new understandings that may have resulted from it – because the research was done informally, in a vacuum of sorts.

Manually gathering data can lead to other hidden costs as well. For instance, many departments and programs in this community college district expended additional staff time checking to make sure that manual insertions of data were accurate. Systematic data entry and checking generally lead to predictable and routine costs and are drawn from

administrative budgets. However, idiosyncratic data gathering leads to unpredictable costs that can negatively impact budgets that have been dedicated to academic or other services rather than administration. Also, the manual gathering of data requires the same hidden costs of staff time, week after week, quarter after quarter.

Of course, information systems cannot be expected to serve every need. However, when the workaround itself becomes calcified – in this case, when the manual manipulations are so prevalent that they become routine – this represents time and resources wasted at the organizational level. As educational institutions consider their technological and information infrastructures, these kinds of issues need to be examined and addressed.

An information environment that is dominated by workarounds also incurs additional hidden costs represented by lost opportunity – those who have given up on using data and information to improve programs and services. For example, while there were those people who actively developed workarounds for their data needs, there were also cases of people who had turned away from using data to inform their programs and services. For these people, when given the time-consuming nature of maintaining workarounds, some simply chose not to gather or use data altogether.

This type of reaction to the information environment can be extremely damaging to the organization because it can prevent people from otherwise engaging in self-reflective research that can improve the organization as a whole. In addition, we found that the challenging data environment at this college district not only limited individual opportunities for exploring improvement, but also had negative repercussions on the ability of the district to respond flexibly to external demands and needs. One participant explained:

And so when you sit down to write a report, a lot of it is conjecture, where you hope that things are going. And you're asked often by the Chancellor or the President to improve rates of under-prepared students, and you have a really difficult time even identifying who is under-prepared, and then you're expected to set goals and rates that you can't measure. You can't be accountable if you don't have the data, and that's what we're finding.

In a tight fiscal environment, each college's ability to respond flexibly and to represent itself well to external audiences can be crucial in helping to meet its ongoing needs.

### **The benefits of the workaround**

In most higher education environments where there are internal and external pressures for organizational improvement, there will always be needs for data and information that are temporary and local rather than ongoing and college-wide. That is, there are many temporary and local needs that cannot and should not be met by formal centralized information systems, primarily because it is more cost-effective and flexible to meet these kinds of needs at the program level rather than with a college-wide solution. Likewise, even at the district-wide level, there are also one-time needs for data that are best handled outside the existing information system. At this research site, the presence of these kinds of data gathering efforts revealed an organization whose employees had a high degree of self-reflection, a willingness to improve services, and an enthusiasm for continuous learning.

Similarly, the presence of workarounds – those local solutions that could better be handled by the information infrastructure – does not necessarily mean that the information infrastructure is inadequate or dysfunctional. As the research literature reveals, informal and individualized patterns of technology use may provide significant benefits not only to the individuals involved, but also to the organization as a whole (McDonnell and Gould, 1998; Sharrock and Anderson, 1996). At this district, the presence of workarounds revealed a significant pattern of innovation and self-reflection on campus. Many of the individuals who had “worked around” the existing data system to “make do” had been able, by and large, to access too much of the data they needed to perform their jobs effectively.

Based on our research at this college, this kind of “do-it-yourself” attitude suggests that the presence of workarounds may reflect an overall innovative research culture within the organization, as well as offers a promising glimpse of where some of the key pockets of

innovation and self-reflection exist. It is true that those who have not employed workarounds may indeed be willing to engage in self-reflection and organizational improvement through effective use of data and information, if given the organizational support to do so. Those who have employed workarounds appear to be willing, at least for a limited time, to engage in such efforts *without* organizational support. For organizations interested in creating a more self-reflective culture on campus, those who are already engaged in workarounds suggest a promising group of individuals to get on board.

As well as revealing where much of the energy for cultures of inquiry may lie within the organization, the existence of workarounds can also reveal where the information technology gaps may exist on campus. People employ workarounds because they have not been able to obtain what they need from the central information systems. Centralized information systems can never be as flexible as employees and programs require, which means that there will always be gaps between what a centralized system can provide and what at least some employees and programs would like to have. As a result, workarounds will always, to some extent and for a limited time, be necessary within a vibrant, self-reflective organization. In this community college, the presence of workarounds served to highlight where the gaps in information flow were. The clusters of workarounds could suggest promising areas of attention as the district works toward improving its information system.

## Conclusion

Our research shows that the primary costs associated with the pervasiveness of workarounds can be identified in the prevalence of local databases, manual data collection, and the lost opportunities represented by those who have given up using data and information to improve programs and services. These costs can be very significant for colleges and universities, and ought to be considered as they consider plans for improving their use of data and information for organizational improvement.

However, our research also suggests that the existence of a limited number of temporary

workarounds within an organization can reveal a dynamic organizational culture that is enterprising and willing to improvise. Over time, however, organizations that maintain a technological environment that is insufficient to meet the organizational needs for data and information can promote the calcification of workarounds, the costs of which in terms of staff time, lost opportunity, and other problems may be significant. The workarounds themselves offer a blueprint for identifying the pressing information gaps that need to be resolved when considering improvements in an information system, and whom to “get on board” in making decisions concerning such an implementation.

## Note

- 1 Seventeen percent of the administrators reported collecting workaround data, 20 percent of staff, and 23 percent of faculty.

## References

- Burke, J.C. and Minassians, H. (2001), *Linking State Resources to Campus Results: From Fad to Trend, The Fifth Annual Survey*, Rockefeller Institute of Government, Albany, NY.
- Ciborra, C. (1996), “Improvisation and information technology in organizations”, *Proceedings of the Seventeenth International Conference on Information Systems*, ACM Press, New York, NY.
- Coate, L.E. (1996), “Beyond re-engineering: changing the organizational paradigm”, *Organizational Paradigm Shifts*, National Association of College and University Business Officers (NACUBO), Washington, DC.
- Davenport, T.H. (1997), *Information Ecology: Mastering the Information and Knowledge Environment*, Oxford University Press, New York, NY.
- Flanagan, J.C. (1954), “The critical incident technique”, *Psychological Bulletin*, Vol. 51 No. 4, pp. 327-58.
- Friedman, D. and Hoffman, P. (2001), “The politics of information”, *Change*, Vol. 33 No. 2, pp. 50-7.
- Grudin, J. (1990), “Groupware and cooperative work: problems and prospects”, in Laurel, B. (Ed.), *The Art of Human Computer Interface Design*, Addison-Wesley, Cambridge, MA, USA.
- Hayes, N. (2000), “Work-arounds and boundary crossing in a high tech optronics company: the role of co-operative workflow technologies”, *Computer Supported Cooperative Work*, Vol. 9, pp. 435-55.
- Jones, P.H. (2000), “Embedded values in innovation practice: toward a theory of power and participation in organizations”, The Union Institute, Available at

- Web site: <http://www.redesignresearch.com/diss.htm>, Accessed: 23 April 2003.
- Levine, L. (2001), "Integrating knowledge and processes in a learning organization", *Information Systems Management*, Vol. 18 No. 1, pp. 21-33.
- McDonnell, J.T. and Gould, S.J. (1998), "Creating an environment to encourage emergent strategy", *PDC 98 Proceedings of the Participatory Design Conference*, Seattle, November, Computer Professionals for Social Responsibility, Palo Alto, pp. 157-66.
- Moran, T.P. and Anderson, R.J. (1990), "The work-a-day world as a paradigm for CSCW design", *Proceedings from Conference on CSCW '90*, Los Angeles, CA, ACM Press, New York, NY.
- Oblinger, D.G. and Rush, S.C. (Eds) (1997), *The Learning Revolution: The Challenge of Information Technology in the Academy*, Anker Publishing Co., Boston, MA.
- Petrides, L.A. (2002), "Organizational learning and the case for knowledge-based systems", in Serban, A.M. and Luan, J. (Eds), *Knowledge Management: Building a Competitive Advantage in Higher Education*, New Directions for Institutional Research, No. 113, Jossey-Bass, San Francisco, CA, pp. 69-84.
- Sharrock, W. and Anderson, B. (1996), "Organizational innovation and the articulation of the design space", in Moran, T. and Carroll, J. (Eds), *Design Rationale*, Lawrence Erlbaum Associates, Mahwah, NJ, pp. 429-51.
- Sirotnik, K.A. and Burstein, L. (1987), "Making sense out of comprehensive school-based information systems: an exploratory investigation", in Bank, A. and Williams, R.C. (Eds), *Information Systems and School Improvement: Inventing the Future*, Teachers College Press, New York, NY.
- Telem, M. (1996), "MIS implementation in schools: a systems socio-technical framework", *Computers in Education*, Vol. 27 No. 2, pp. 85-93.
- Wells, J., Silk, E. and Torres, D. (1999), "Accountability, technology, and external access to information: implications for IR", in Sanders, L. (Ed.), *How Technology is Changing Institutional Research*, New Directions for Institutional Research, No. 103, Jossey-Bass, San Francisco, pp. 23-9.
- Western Association of Schools and Colleges (WASC) (2002), "Evidence guide: a guide to using evidence in the accreditation process: a resource to support institutions and evaluation teams", working draft, Alameda, CA.