IDC Analyze the Future

Global Headquarters: 5 Speen Street Framingham, MA 01701 USA P.508.872.8200 F.508.935.4015 www.idc.com

WHITE PAPER

Bridging the Information Worker Productivity Gap in Western Europe: New Challenges and Opportunities for IT

Sponsored by: Adobe

Melissa Webster

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EXECUTIVE SUMMARY

In June 2012, IDC undertook a global survey of information workers and IT professionals in the United States, the United Kingdom, France, Germany, Australia, and Japan to better understand today's information worker needs and challenges. A key goal of our survey was to uncover significant time wasters and opportunities to address workforce productivity. This paper reports our findings and provides recommendations for IT.

Our survey shows that information workers in Western Europe waste a significant amount of time each week dealing with a variety of challenges related to working with documents. This wasted time costs the organization €14,492 per information worker per year and amounts to a loss of 19.5% in the organization's total productivity.[1] For an organization with 1,000 people, addressing these time wasters would be tantamount to hiring 195 new employees.

This should be welcome news for executives seeking to redeploy resources to spur innovation, increase profits, and compete effectively in new markets. It should also capture the attention of CIOs who have been tasked with increasing the organization's productivity. In IDC's 2011 survey of CIOs in the United States and Western Europe, CIOs ranked increasing productivity third on the list of business initiatives that were expected to drive IT investment in 2012 — just behind reducing the organization's costs and improving the organization's business processes.[2]

IT is responding with new investments in collaboration tools. Asked about key IT initiatives for 2012, CIOs ranked improving the organization's collaboration tools third — behind cloud services and consolidation/virtualization and ahead of big data and analytics, application consolidation, security and risk management, and a host of other key IT initiatives. Translating investments in collaboration tools into real productivity gains has proven to be somewhat elusive in the past, as a decade of IDC research into the hidden costs of information work shows. What is standing in the way?

One of the key findings of our June 2012 survey is that information work is inherently document intensive. Much of the time that information workers spend at work involves working with documents or forms in one way or another — whether researching and

[1] See the Appendix for the survey methodology and an explanation of how costs are calculated.

[2] *The CIO Agenda for 2012 and Beyond: A Look at CIO Sentiment and Priorities*, IDC #233098, February 2012

pulling information together for documents; reviewing, approving, and signing documents; managing the document review process; or working with forms and forms data. General-purpose collaboration tools don't fully address information workers' needs related to these *document-based* activities.

Specifically, information workers need tools and best practices that make them more productive in the following areas:

- Creating and managing documents
- Collaborating around documents and working with forms
- Working with documents on mobile devices

As our June 2012 survey also found, some significant gaps in perception exist between information workers and IT when it comes to current and future needs — gaps that will only widen with the rapid growth of cloud and mobile computing. Closing these perception gaps is essential if IT is to deliver against its key productivity improvement objectives, and this paper looks to help IT achieve that goal.

KEY CHARACTERISTICS OF INFORMATION WORK

If we stop to consider how information work has changed over the past decade, we see that many of the changes have been dramatic. A far greater percentage of employees work remotely or from a home office today, and workgroups often span the globe. Web and video conferencing and tools such as instant messaging and instant meetings let people collaborate in real time across distance, time zones, and organizational boundaries, and mobile devices help them be productive "on the go." Increasingly, enterprise social networks are enabling information workers to share and find relevant information, locate needed expertise, and come together in self-organizing groups.

No one would argue that investments in collaboration tools haven't brought returns; they have. At the same time, as our research over the past decade into the hidden costs of information work shows, information workers continue to waste a significant number of hours each week on a variety of unproductive activities.

Certainly, many factors can contribute to this loss in productivity. In some cases, the culprit is inefficient business processes and/or lack of automation. To some extent, it's the result of too many separate applications that force the information worker to become "the glue" between multiple systems.

To gain a better understanding of the nature of information work today — and glean insights into the activities that cost information workers time — IDC conducted a global survey of 1,200 information workers and IT professionals in the United States, the United Kingdom, France, Germany, Australia, and Japan in June 2012. Our survey results highlight significant differences in perceptions between information workers and IT around current and future needs and reveal opportunities to improve workforce productivity. This paper provides a detailed analysis of our findings for Western Europe.

Information Work Is Document Intensive

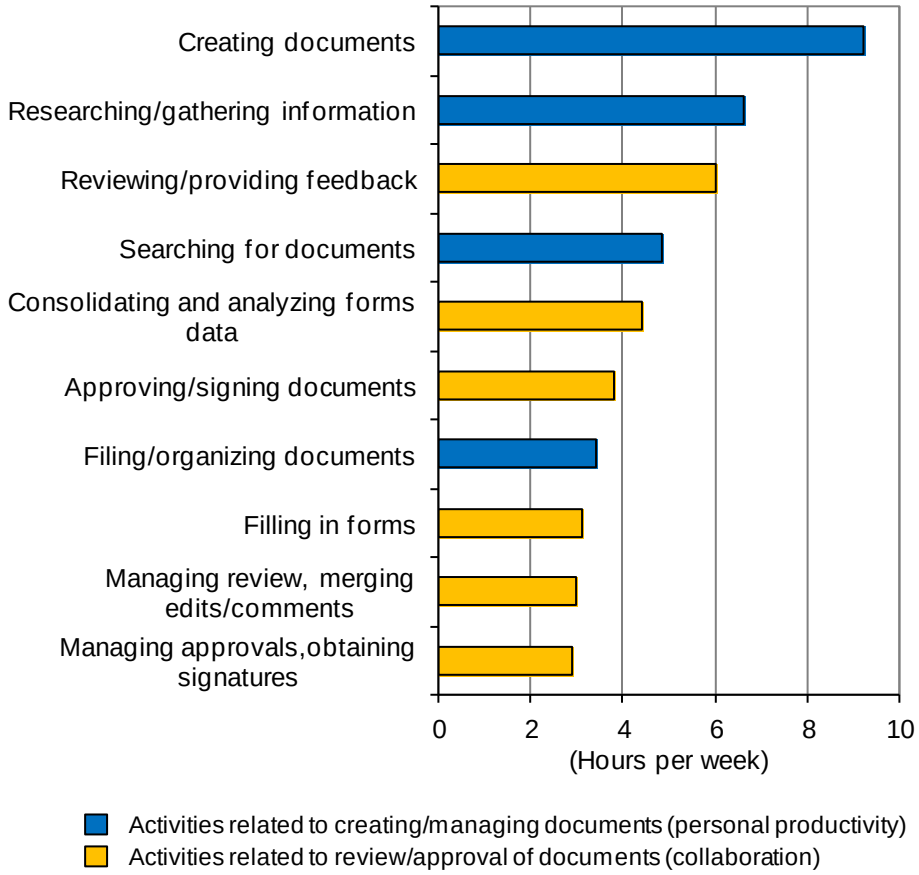
Our survey reveals that information workers spend most of their time at work each week performing one document-related activity or another (see Figure 1).

Information workers spend most of their time at work each week performing one document-related activity or another.

FIGURE 1

Information Work in Western Europe Is Highly Document Centric

Q. Thinking about your typical workweek, how many hours would you say you spend on the following document-related activities?



n = 420 information workers in Western Europe, evenly split across the United Kingdom, France, and Germany

Notes:

Multiple responses were allowed.

Total is 47.1 hours, which is greater than the 44.3 hours information workers say they work each week; subsequent calculations are based on the higher number (47.1). (See the methodology in the Appendix.)

Source: IDC's *Information Worker Survey*, June 2012

Information workers spend half their time in activities related to document creation and management, including researching and gathering information for documents, searching for documents, and filing and organizing documents. This is time spent working individually, where tools that help improve personal productivity come into play.

Information workers spend half their time in activities related to document creation and management, and they spend the other half in activities that involve working collaboratively with documents.

They spend the other half of their time in activities that involve working collaboratively with documents — that is, getting their documents reviewed and approved; merging edits and comments from multiple reviewers/versions into a single document; managing approvals and obtaining signatures, wet stamps, or other marks of approval on documents; reviewing documents received from others and providing feedback; approving or signing documents; and dealing with forms or forms data. Almost two-thirds of this time is spent collaborating with people who don't sit nearby — that is, people from the information worker's team who work from other locations, people in other groups, and people from outside the organization. This is where collaborative tools can help bridge distance, time zones, and organizational boundaries.

Information workers today increasingly require the ability to work "on the go." Most want to use their mobile devices to perform the same document-related tasks they use their PCs for today. All of these devices are being connected to the organization's network and email systems, and this adds to the complexity of managing networks and applications for IT.

Information workers need to be able to work "on the go" using smartphones and tablets. Most want to use their mobile devices to perform the same document-related tasks they use their PCs for today.

Further, as our survey shows, the "bring your own device" (BYOD) trend has begun to take root in Western Europe: 13% of the smartphones information workers use at work — and more than a third of the tablets — are BYOD today. This further exacerbates challenges around document and application security and is forcing IT to rethink its approach to device and information management.

In any case, the demand for mobility is not something IT can resist — no matter how much it might wish to: It is being driven by information workers at every level of the organization today, from executives on down.

Information Workers Spend Hours Each Week Dealing with Document Challenges

Despite significant investments in personal productivity tools and collaborative applications over the past several years, information workers in Western Europe spend a significant percentage (43.3%) of their time dealing with a variety of challenges and frustrations related to working with documents (see Figure 2).

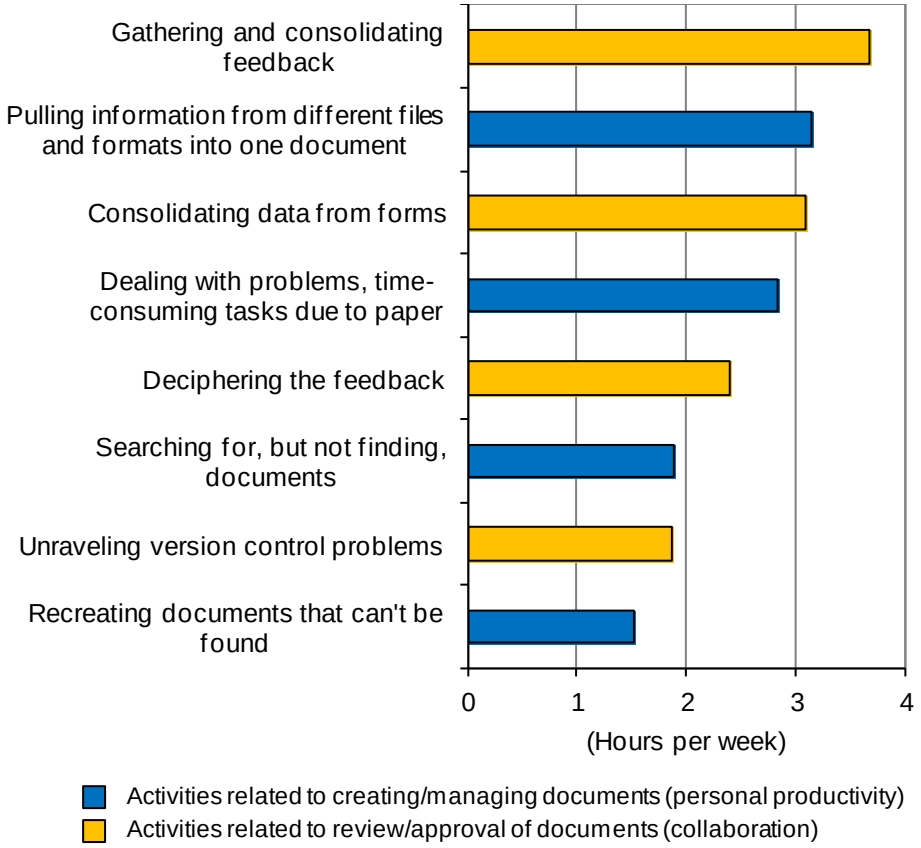
Time wasted in the course of dealing with document-related challenges costs the organization €14,492 per information worker per year in compensation costs alone.

As our research shows, much of this time is wasted time: IDC estimates wasted time costs the organization €14,492 per information worker per year in compensation costs alone.

FIGURE 2

Information Workers in Western Europe Spend a Significant Percentage of Their Time Dealing with a Variety of Document Challenges

Q. There are many things that can take up a lot of extra time when working with documents. How many hours a week do you spend on each of the following?



n = 420 information workers in Western Europe, evenly split across the United Kingdom, France, and Germany

Notes:

Multiple responses were allowed.

Total is 20.4 hours, or 43.3% of the time spent on Figure 1 activities.

Source: IDC's *Information Worker Survey*, June 2012

Subsequent sections of this study look in more detail at the three areas we highlighted previously — areas we believe IT should target for productivity improvements: creating and managing documents (personal productivity), collaborating with others around documents, and working with documents on mobile devices. We believe IT has an opportunity to make improvements fairly inexpensively.

BOOSTING INFORMATION WORKERS' PERSONAL PRODUCTIVITY

Let's begin with information worker challenges related to personal productivity. Information workers in Western Europe spend 9.4 hours per week dealing with challenges around creating and managing content (see Table 1). Much of this is wasted time.

Fruitless searches and missed opportunities for content reuse are entirely wasted time, and at least a quarter of the time information workers spend dealing with issues that arise using paper documents and pulling information together from multiple sources into one document is also wasted time. This means they waste 4.9 hours per week dealing with challenges related to document creation and management.

Information workers spend 9.4 hours a week dealing with challenges related to document creation and management. At least 4.9 hours of this is wasted time.

TABLE 1

Information Worker Time Spent/Wasted Dealing with Challenges Related to Personal Productivity in Western Europe

	Hours Spent per Week	% of Time Spent	Hours Wasted per Week	% of Time Wasted	% of Organizational Productivity Lost
Pulling information that exists in different files and formats together in one document	3.1	6.7%	0.8	1.7%	1.3%
Dealing with problems and time-consuming tasks that arise with paper documents	2.8	6.0%	0.7	1.5%	1.2%
Searching for, but not finding, documents	1.9	4.0%	1.9	4.0%	3.2%
Recreating documents because the current or the right version can't be found or got lost	1.5	3.2%	1.5	3.2%	2.6%
Total	9.4	19.9%	4.9	10.4%	8.4%

n = 420 information workers in Western Europe, evenly split across the United Kingdom, France, and Germany

Notes:

Percentages are based on reported 47.1 hours per week spent on Figure 1 activities and 80.6% of employees being information workers. (See the methodology in the Appendix.)

All numbers in this table may not be exact due to rounding.

Source: IDC's *Information Worker Survey*, June 2012

Time wasted in document creation and management activities costs the organization €6,250 per information worker per year. The cost in lost productivity is huge when we add this up for the organization as a whole: It amounts to an 8.4% loss in the organization's total productivity. Eliminating the time wasters related to creating and managing documents would be equivalent to adding 84 new employees in a 1,000-person company.

Time wasted in document creation and management activities costs the organization €6,250 per information worker per year.

Persistence of Paper Documents a Contributor

Despite attempts to eliminate paper via document automation and other technologies over the years, paper continues to be prevalent. We asked information workers in Western Europe what percentage of the time they spend dealing with documents is spent working with documents in paper rather than electronic form; the answer is 21.9%. Use of paper is declining, but only modestly: 38.1% of information workers in Western Europe say the percentage of documents they deal with that are paper based has declined in the past year, but 13.3% say it has increased. As noted previously, dealing with problems and time-consuming tasks that arise with paper documents eats up 2.8 hours of an information worker's time each week.

Paper continues to be prevalent: 21.9% of the time information workers spend dealing with documents is spent working with paper documents today.

Reasons for the persistence of paper include requirements for physical signatures (and lack of comfort with electronic signatures), old habits, the need to file or submit documents in paper form (or fill out forms by hand), and the need to print documents for use in the field where it's difficult to take along a PC.

IT is somewhat aware of the continued reliance on paper: Over a third of IT respondents say their organization's systems are still far too paper based. IT underestimates the impact this has, however, on both productivity and costs.

Implications for IT

IT needs to focus more attention on improving information workers' personal productivity related to creating and managing documents and eliminating the time wasters. Content management and search technologies are only part of the answer.

IT should engage with information workers to define strategies for reducing the need for paper and improving the efficiency of business processes that require transitions in and out of paper. Paper documents aren't searchable and are difficult to manage, and we believe the persistence of paper documents and forms in the organization is a contributor to all of the time wasters itemized in Table 1. Capture, esignatures (where legally enforceable or recognized), vaulting, and other document-based technologies can help address many of the root causes of the continued reliance on paper. Increased use of tablets can help here too: IDC research shows tablet users print significantly fewer documents. We believe information workers are aware of the disadvantages of paper-based documents and are looking to IT for help with both tools and best practices.

Capture, esignatures (where legally enforceable or recognized), vaulting, and other document-based technologies can help address many of the root causes of the continued reliance on paper.

Document-oriented technologies can also make it easier for information workers to pull information together from multiple electronic formats/sources to create new documents and create "collections" of related documents that can be managed as single objects with rich metadata that makes the content more discoverable.

Document-oriented technologies make it easier to pull information together from multiple formats/sources, create new documents from existing content, and create "collections" of related documents.

ADDRESSING INFORMATION WORKERS' DOCUMENT COLLABORATION NEEDS

As noted previously, information work in Western Europe is highly collaborative: On average, information workers spend a little over half their time collaborating with others inside and outside the organization. A majority of this time is spent

collaborating with people in other locations, departments, or organizations — underscoring the need for tools that make it easier to collaborate across distance, time zones, and organizational boundaries.

Time spent collaborating includes time spent on document review and approval processes and dealing with forms and forms data. Information workers in Western Europe spend almost a quarter of their workweek dealing with challenges related to document review and approval and working with forms (see Table 2).

Information workers in Western Europe spend almost a quarter of their workweek dealing with challenges related to document review and approval and working with forms.

Again, much of this is wasted time. Time spent unraveling version control issues that are created by awkward collaborative processes and consolidating data from forms (a task that begs for better automation) is entirely wasted time. Similarly, we estimate conservatively that a quarter of the time information workers spend gathering and consolidating feedback and deciphering that feedback could be eliminated through the use of better document-based collaboration tools.

TABLE 2

Information Worker Time Spent/Wasted Dealing with Challenges Related to Collaboration in Western Europe

	Hours Spent per Week	% of Time Spent	Hours Wasted per Week	% of Time Wasted	% of Organizational Productivity Lost
Gathering everyone's feedback and consolidating it into a single document	3.7	7.8%	0.9	1.9%	1.6%
Consolidating data from forms	3.1	6.6%	3.1	6.6%	5.3%
Deciphering the feedback	2.4	5.1%	0.6	1.3%	1.0%
Unraveling version control problems created by awkward routing, review, approval, or signature processes	1.9	4.0%	1.9	4.0%	3.2%
Total	11.0	23.4%	6.5	13.7%	11.1%

n = 420 information workers in Western Europe, evenly split across the United Kingdom, France, and Germany

Notes:

Percentages are based on reported 47.1 hours per week spent on Figure 1 activities and 80.6% of employees being information workers. (See the methodology in the Appendix.)

All numbers in this table may not be exact due to rounding.

Source: IDC's *Information Worker Survey*, June 2012

This adds up to 6.5 hours of wasted time each week at an annual cost of €8,242 per information worker. Again, the cost to the organization in lost productivity is enormous: an 11.1% drop in total productivity. Addressing these time wasters would be the equivalent of adding 111 new employees in a 1,000-person company.

Information workers waste 6.5 hours per week dealing with document collaboration challenges — at an annual cost of €8,242 per information worker.

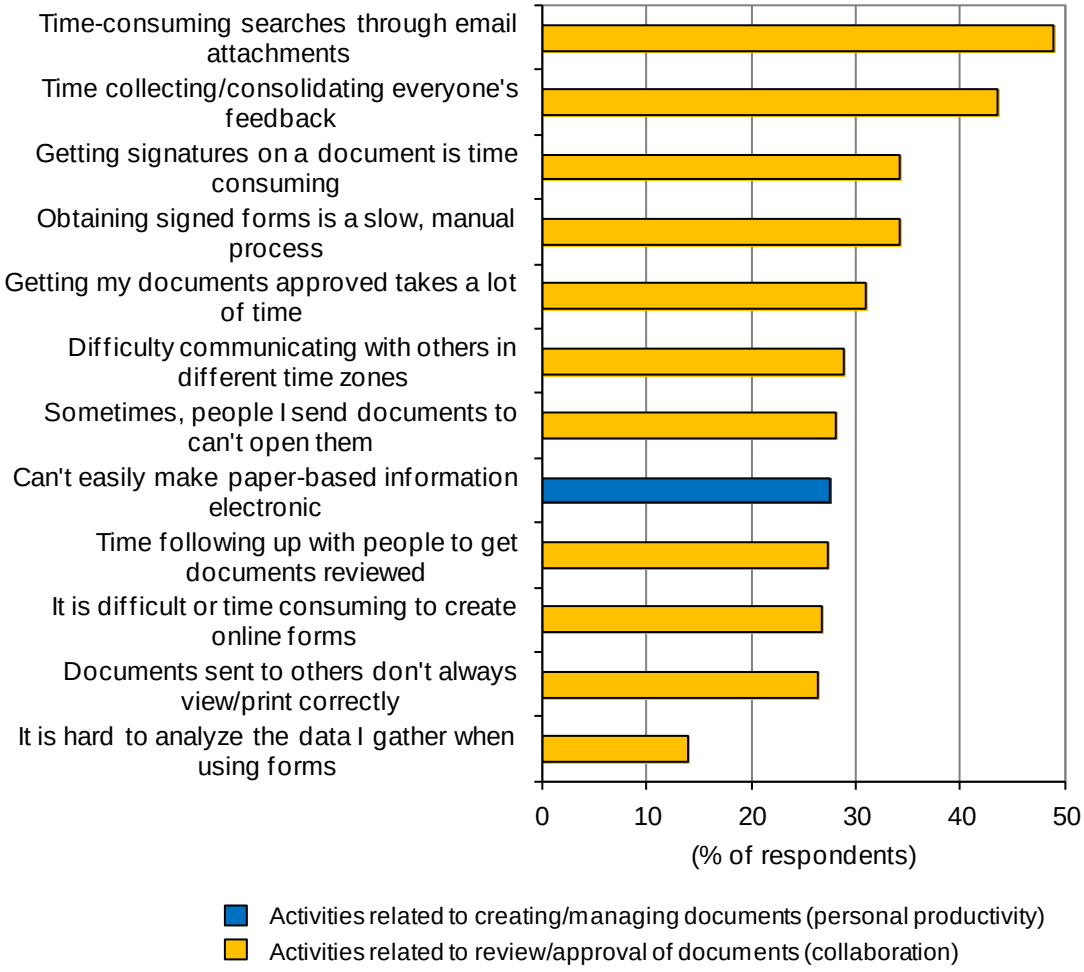
Need for Document-Based Collaboration

Time wasted in edit, review, and approval processes and dealing with forms can be traced to a variety of frustrations that improved document collaboration processes can significantly ameliorate or eliminate altogether (see Figure 3).

FIGURE 3

Information Worker Frustrations Related to Working with Documents in Western Europe

Q. What are some of the biggest frustrations you face working with documents?



n = 420 information workers in Western Europe, evenly split across the United Kingdom, France, and Germany

Note: The figure shows the percentage of respondents who rated each item 4 or 5 on a scale of 1 to 5, where 1 means they strongly disagree and 5 means they strongly agree.

Source: IDC's *Information Worker Survey*, June 2012

These findings suggest that the general-purpose collaborative applications provided to information workers in the past (including messaging, team sites, conferencing, and so forth) don't fully address the highly document-centric nature of information work: Information workers also need support for *document-based collaboration* (see Figure 4). Capabilities include:

General-purpose collaborative applications don't fully address the highly document-centric nature of information work: Information workers also need support for *document-based collaboration.*

- **Commenting and annotation.** Two-thirds of information workers in Western Europe say being able to see other people's comments on documents they have been given to review and/or the use of commenting tools in the document itself would save them time.

- **Document portability and fidelity.** More than a quarter of information workers in Western Europe say the people to whom they send documents can't always open them (because they don't use the same desktop software); similarly, more than a quarter say the people to whom they send documents can't always view or print them correctly. Altogether, more than a third of information workers in Western Europe cite one or both of these frustrations. Information workers in smaller companies are more affected than those in larger companies, likely because larger companies have standardized their desktop software to a greater extent. Still, this is a significant area of frustration for information workers across the board.

- **eForms.** Forms-related workflows are an area of frustration for half of information workers. Information workers in Western Europe spend 7.5 hours per week filling in forms and consolidating/analyzing information they have collected via forms; nearly half of this is wasted time. Today, this is largely a manual effort: Only 4% of our information worker respondents in Western Europe are using an electronic forms product.

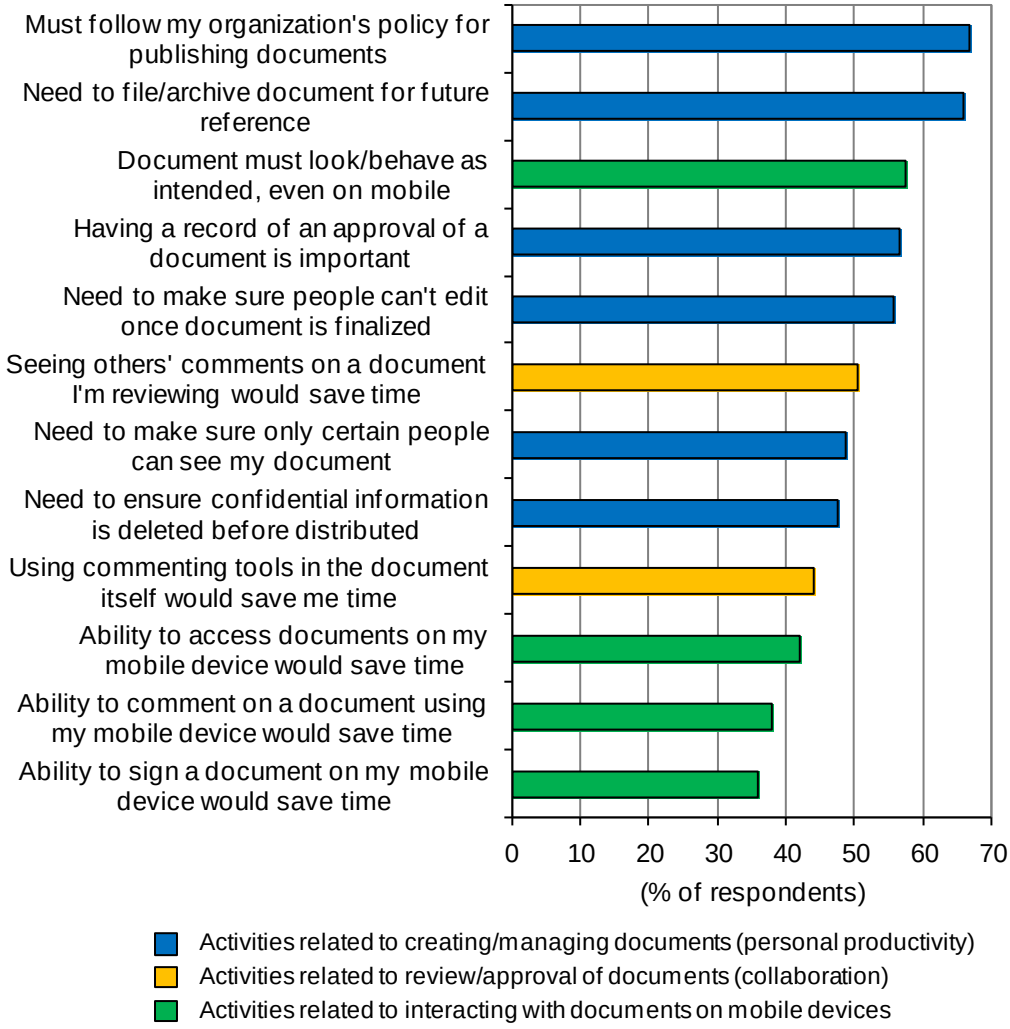
- **Signatures and approvals.** Information workers in Western Europe spend 6.7 hours per week obtaining signatures on documents and getting documents approved, as well as signing or approving documents. This is a good target for better automation.

- **Document security and governance.** The moment a document leaves the author's hands, document security concerns begin — especially when a document is shared with external collaborators.

FIGURE 4

Specific Information Worker Needs in Working with Documents in Western Europe

Q. Regarding your specific needs related to working with documents, please rate the following...



n = 420 information workers in Western Europe, evenly split across the United Kingdom, France, and Germany

Note: The figure shows the percentage of respondents who rated each item 4 or 5 on a scale of 1 to 5, where 1 means they strongly disagree and 5 means they strongly agree.

Source: IDC's *Information Worker Survey*, June 2012

Importance of External Collaboration

IT seriously underestimates the importance of external collaboration to the organization's information workers. We asked IT respondents in Western Europe what percentage of their employees collaborate with people outside the organization; their answer was just 23.4%. (The number wasn't much higher when we asked what they thought this percentage would be two years from now.) In fact, 91.4% of information workers already collaborate with people outside the organization on a weekly basis, and the average information worker spends 4.8 hours per week doing so.

IT seriously underestimates the importance of external collaboration. The vast majority of information workers collaborate with people outside the organization on a weekly basis.

SaaS Adoption

In organizations where IT fails to address information workers' external collaboration needs, information workers devise their own strategies. The need for easy collaboration and sharing of documents with people outside the organization has driven user adoption of cloud-based (SaaS) file upload/sharing services, many of which are geared more to consumers than enterprises.

In organizations where IT fails to address information workers' external collaboration needs, information workers devise their own strategies. This has driven adoption of SaaS file sharing services, many of which are geared more to consumers.

IT organizations in Western Europe are aware of this and are struggling to respond by putting policies in place. These policies range widely from forbidding employees to use SaaS services that are not expressly sanctioned and supported by IT (54.4%) to trying to discourage the use of such services (18.9%) to capitulating and letting users do as they wish (4.4%). Increasingly, IT is engaging with users to understand their needs and put solutions in place to support them — solutions that keep IT in control and ensure information is secure (15.6%). Some are embracing a cloud-first strategy (6.7%).

SaaS is on IT's radar: One-fifth of information worker applications in Western Europe are SaaS today, and IT respondents expect this percentage to grow to more than a third within two years. IT expects to increase SaaS use across a variety of collaboration use cases, including email/calendar, online forms, Web and video conferencing, team sites, extranets, online file sharing, and esignatures.

As we know from other IDC research, concerns around compliance with country-specific laws that enact the EU Data Protection Directive play a role in deciding how and where cloud services are used. Still, in this day and age, two years is a long time frame, and we think IT needs to be more aggressive — especially where external collaboration is involved. Just 22.8% of IT organizations in Western Europe have deployed a SaaS extranet solution today to at least 10% of their users. Past efforts to develop and deploy extranets to meet users' external collaboration needs haven't been entirely satisfactory: 40.6% of IT respondents say building extranets to enable secure collaboration and file sharing has been an expensive proposition and they need a better alternative. SaaS offers a way forward. Other promising use cases for SaaS that IT should explore include online forms, online file sharing, and esignatures where legally enforceable or recognized.

Document and Application Security

While half of IT respondents in Western Europe agree that enabling easier/better collaboration with people outside the organization is important to users, IT is extremely concerned about the security of information that is exchanged with external collaborators: Three-quarters say it's critical to ensure the security and privacy of information in documents and files — especially when they travel outside the firewall. IT's concerns appear to be well founded: 21.7% say their organization has experienced an information leak within the past 12 months (see Figure 5).

21.7% of IT respondents in Western Europe say their organization has experienced an information leak within the past 12 months.

Organizations are employing a variety of document security strategies to protect sensitive information in their documents, including file encryption, passwords on individual documents, digital signatures/certificates, secure file upload/managed file transfer/portals, and digital rights management (DRM) or enterprise rights management (ERM). Western Europe is in the lead when it comes to the use of digital signatures/certificates (60.6% versus 44.4% outside Europe) and DRM/ERM (38.3% versus 23.3% outside Europe), but use of these technologies varies by country — both are in wider use in France and Germany than in the United Kingdom. (Germany and France were early adopters of digital signatures. Legislation in these countries is more granular due to strict employment and commercial practices; in Germany, greater government regulation of certificate authorities [CAs] has led to a higher level of confidence in the security of digital signatures.) Secure file upload/managed file transfer/portals are in use in about half of organizations (compared with 68.3% in the United States). All of these are valuable strategies and have different applications, and we recommend IT organizations proactively investigate those they haven't already put to use.

Organizations are employing a variety of document security strategies to protect sensitive information in their documents.

The need to manage and secure sensitive information and documents is also closely related to application security, another top concern for IT and the number one issue for 82.8% of IT respondents in Western Europe when it comes to deployment and support of desktop applications — ranking higher than cost, compatibility with IT's existing operating system and application environment, ease of management and deployment, impact on the complexity of the desktop stack, and the skill sets and additional support staff needed to support the software, among other concerns.

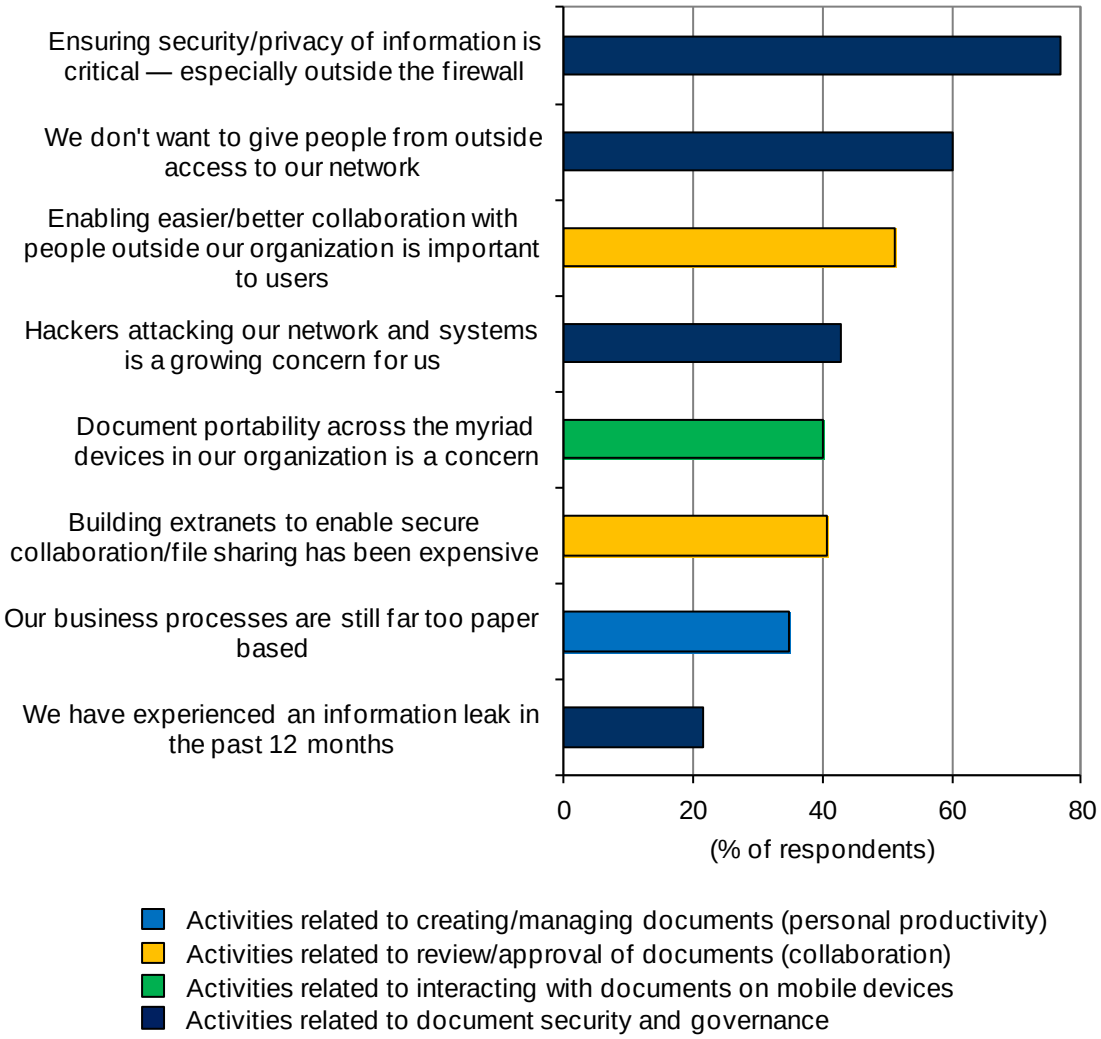
The need to manage and secure sensitive information and documents is also closely related to application security. IT has significant exposure in this particular area, however.

IT has significant exposure in this particular area, however. Only 29.4% of organizations in Western Europe have a policy in place to apply security patches within two weeks of release, and only 58.3% have a policy in place to apply them within a month; about a fifth have no policy at all. This is further complicated by the fact that it is time consuming for IT to manage desktop software upgrades for the existing, predominantly PC-based environment: 38.3% of IT respondents say it takes them more than 45 minutes per PC to roll out an update. Adopting deployment automation tools can significantly reduce the time and effort required.

FIGURE 5

Top-of-Mind IT Concerns in Western Europe

Q. Please rate your level of agreement with the following statements…



n = 180 IT respondents in Western Europe, evenly split across the United Kingdom, France, and Germany

Note: The figure shows the percentage of respondents who rated each item 4 or 5 on a scale of 1 to 5, where 1 means they strongly disagree and 5 means they strongly agree.

Source: IDC's *Information Worker Survey*, June 2012

Implications for IT

Given the significant amount of time information workers waste in activities related to document review and approval and working with forms and forms data, IT should proactively investigate *document-based* collaboration technologies that provide the following capabilities:

- Commenting and annotation, which enable information workers to see others' comments on documents they are reviewing
- Document portability, which ensures information workers can open, view, and print documents others send to them using their device(s) of choice with full fidelity
- eForms, which help automate data collection and consolidation
- eSignatures, which streamline the approval process

The significant gap in perception between IT and information workers around the importance and pervasiveness of external collaboration and sharing may help explain why information worker productivity improvements have been so difficult to achieve. The user base that IT needs to support around collaboration and secure sharing of documents with people outside the firewall is much, much larger than IT realizes, and IT needs to focus greater attention on two key areas: facilitating external collaboration (particularly around sharing of information) and document and application security.

The user base that IT needs to support around collaboration and secure sharing of documents with people outside the firewall is much, much larger than IT realizes.

ADDRESSING INFORMATION WORKERS' PRODUCTIVITY NEEDS ON THE GO: MOBILE

Information workers want to be more productive "on the go" and are pushing IT for support. The number of mobile devices on the enterprise network has grown rapidly over the past few years:

- Half of information workers in Western Europe use a smartphone for work today, and nearly two-thirds expect to a year from now.
- 13.8% of information workers use a tablet for work today, and a third expect to a year from now.

The push for smartphones has been driven by information workers at all levels of the organization. Tablets, on the other hand, have been driven largely by executives. There have been plenty of stories in the press about CEOs marching into IT and demanding email and network support for their iPads, and our survey data suggests this trend will continue: More than a third of executive information workers in Western Europe use tablets for work purposes today, and almost two-thirds expect to within the next 12 months.

Mobile Use Cases

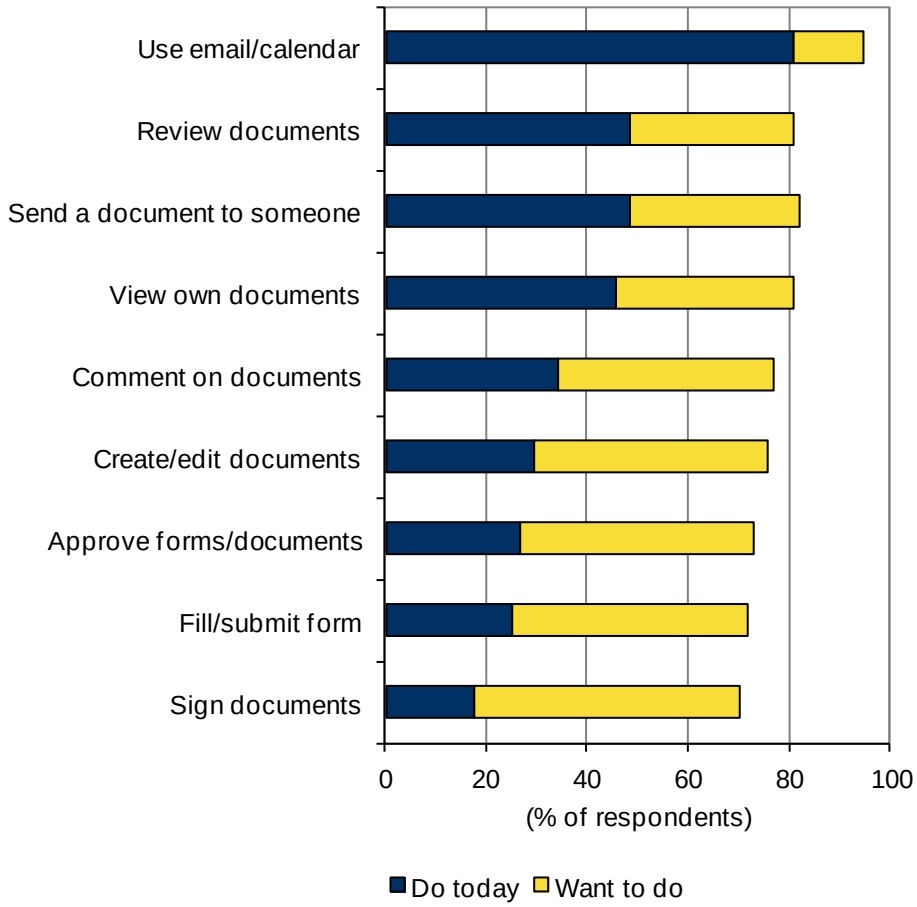
Information workers in Western Europe who use mobile devices for work are using their mobile devices to perform many of the same document-oriented tasks they perform on their PCs, and they hope to be able to do a lot more with documents in the future (see Figure 6).

Information workers in Western Europe perform many of the same document-oriented tasks on their mobile devices that they perform on their PCs, and they hope to be able to do a lot more in the future.

FIGURE 6

Information Worker Use Cases for Mobile Devices in Western Europe

Q. Which of the following work-related activities are things you are doing today using a smartphone or tablet, and which are things you would like to be able to do?



n = 420 information workers in Western Europe, evenly split across the United Kingdom, France, and Germany

Base = current mobile device users, n = 215

Source: IDC's *Information Worker Survey*, June 2012

In our conversations with IT organizations about mobile collaboration, we often hear that once users are given access to email and calendaring from their mobile device(s), they then request access to documents. Certainly, the need to open and view email attachments is a catalyst, but as our survey shows, information workers want to be able to perform the full range of document-oriented activities using their mobile devices — whether it's commenting on, editing, or signing documents; filling out forms; or approving forms or documents. As Figure 4 shows, information workers believe the ability to access, comment on, and electronically sign documents using their mobile devices will save them time and improve their productivity.

Our survey results suggest that IT is in reactive mode when it comes to mobile productivity and is somewhat underestimating information worker demand. For example:

- While half of information workers in Western Europe use a smartphone for work today, IT's estimate is closer to a third; and while nearly two-thirds of information workers expect to be using a smartphone a year from now, IT's estimate is that about half of information workers will be using a smartphone two years from now.
- Three-quarters of smartphone and tablet users would like to be able to perform the full range of document use cases listed in Figure 6. While more than three-quarters of IT organizations in Western Europe plan to enable these use cases in the next two years or are evaluating them, only a little over a third of IT organizations support these use cases today.

Support for BYOD

As noted previously, a growing percentage of the mobile devices attached to the enterprise network are provided by employees. Here, too, we find a gap in perception between information workers and IT in Western Europe: According to information workers in Western Europe, 13% of the smartphones and more than a third of the tablets they use for work are BYOD; IT's estimate is close for smartphones (10.1%) but is much lower (6.6%) for tablets.

Although IT foresees growth in these percentages over the next two years, IT appears to be responding cautiously to user demand: Only 19.4% of IT respondents in Western Europe say their organization is encouraging employees to bring their own devices to work.

Implications for IT

We believe information workers will continue to push for mobile enablement of document use cases, and IT needs to provide more proactive support. In some organizations, mobile support is provided by a separate team (or is outsourced entirely), which can reduce IT's visibility into emerging user needs. IT needs to decide whether mobile devices represent a tactical convenience or a strategic platform for information worker productivity and application deployment — and plan accordingly.

We also expect user demand for BYOD will continue to grow. Embracing BYOD can offer significant cost savings to the organization: Some IT organizations we have spoken with tell us BYOD is allowing them to shift the responsibility for monthly carrier charges back to the employee, reversing the decades-old trend to company-provided mobile phones.

User demand for BYOD will continue to grow. Embracing BYOD can offer significant cost savings to the organization.

As employee-owned devices increasingly hold sensitive documents and other confidential information, IT's role is shifting away from device management to the management of the information on those devices. Document security will become more important.

In addition, IT must also evolve its desktop management practices — especially in an increasingly multidevice world. Two-thirds of IT respondents are already factoring in device support when planning new desktop software purchases, and IT is embracing a variety of strategies that simplify application provisioning and management, such as software and hardware consolidation, client virtualization, and "hotdesk" strategies. But managing networks that are characterized by the rapid proliferation of devices of all types — a proliferation that is accelerated by BYOD — represents a major challenge for IT. Going forward, better automation of desktop and application management will become increasingly important to freeing up IT resources for innovation and new solution delivery.

IT must evolve its desktop management practices — especially in an increasingly multidevice world — if it is to free up resources for innovation and new solution delivery.

IMPORTANCE OF DOCUMENT STANDARDS

With the rise of mobile computing, the importance of document standards has once again come to the fore: Standards are critical for document interoperability across diverse computing platforms, and given the central role documents play in the life of an information worker, strong support for widely adopted document standards should be an important criterion for desktop software evaluation.

Document standards generally fall into two categories:

- Authoring standards (e.g., ODF and OpenXML)
- Distribution standards (e.g., PDF, EPUB)

Generally, authoring standards are good for document creation but aren't strong when it comes to document sharing and collaboration, which is where document distribution standards come into play. Without standards, information workers have no guarantee that those with whom they share documents will be able to open, view, or print them with full fidelity.

The PDF Standard

Portable Document Format (PDF) is a file format that encodes and renders documents in a manner that is independent of both the application software (authoring tools) used to create them and the computing platforms (hardware and operating systems) used to view them. PDF supports rich media, embedded Web links, CAD information and vector graphics, and other types of content, including 3D diagrams. The PDF standard, which includes several specializations defined for specific use cases, is published by the International Organization for Standardization as ISO 32000.

PDF viewers are ubiquitous and freely available on PCs, smartphones, and tablets, and PDF is by far the most commonly used document distribution standard in organizations today. 78.2% of our IT respondents in Western Europe say PDF is widely used in their organizations, and 70% of our information worker respondents use it (after Microsoft Office, it's the document tool or technology they use the most).

PDF is by far the most commonly used document distribution standard in organizations today.

In addition to printing and distributing documents, PDF is also widely used for archiving. Use of PDF is higher in larger organizations (77.1% of information workers in organizations with 50,000+ employees use PDF versus 61.8% of information workers in organizations with fewer than 500 employees).

PDF-Based Software Solutions

Many vendors have implemented elements of the PDF standard in their software solutions. Authoring tools, for example, may include a "Save as" PDF option for easy PDF creation; this helps smooth the transition from document creation to distribution.

Other vendors offer software tools that implement a more significant percentage of the PDF standard. These tools enable information workers to create interactive PDF documents that provide a richer user experience; for example, filling out a form or interacting with embedded rich media or 3D graphics.

Finally, a few vendors offer tools that extend the PDF standard with additional functionality; these extensions may well find their way into future versions of the PDF standard. In addition to helping information workers with document creation/management and collaboration activities, these tools can help information workers automate some of their document-driven business processes; for example, signing contracts, redacting sensitive information, or "electronifying" paper via optical character recognition (OCR).

Additional Capabilities of Advanced PDF Solutions

Advanced PDF solutions merge multiple document formats and content types into a single document, preserving the original documents' look and feel.

Advanced PDF solutions can help address all three of our information worker productivity areas. For example, in the area of document creation and management, advanced PDF software enables information workers to merge multiple document formats and content types into a single (PDF) document, preserving the original documents' look and feel. They can also append new content to an existing PDF. Support for multiple file attachments and portable collections makes it easy to group associated documents together so they can be managed as a single object. These capabilities can reduce the amount of time information workers waste today pulling information from different files and formats together in one document, searching for documents, and recreating them when they can't be found.

OCR capabilities can help information workers "electronify" their paper documents — making them searchable, reusable, and much easier to manage and reducing the need for paper.

Similarly, advanced PDF software may include OCR capabilities that let information workers "electronify" their paper documents — making them searchable, reusable, and much easier to manage and helping information workers reduce their reliance on paper. The use of PDFs on mobile devices (particularly tablets) offers another opportunity to reduce the amount of paper the organization needs to deal with (the need to print documents so they can be used where it's difficult to take a PC was a leading reason why paper remains prevalent in the organization): As IDC research shows, tablet use significantly reduces printing.

Advanced PDF software can help address the myriad challenges associated with document-based collaboration discussed previously, including gathering and consolidating feedback on a document and eliminating version control problems that arise with awkward routing, review, approval, or signature processes. As noted

previously, electronic forms are underutilized today, and dealing with forms costs the average information worker several hours each week.

Advanced PDF software responds to many of IT's document security and information privacy concerns — especially in regard to documents that travel outside the firewall — with a variety of document protection strategies, some of which (for example, password protection) are already widely used and some of which (for example, digital signatures) deserve to be. Support for redaction gives information workers an important tool for ensuring confidential information is deleted from documents before they are distributed — a pain point that is highlighted in Figure 4.

Advanced PDF software responds to many of IT's document security and information privacy concerns — especially in regard to documents that travel outside the firewall. Such tools implement a broad range of document protection strategies.

Finally, advanced PDF software can provide support for mobile information workers who wish to create, edit, review, sign, and approve documents on their smartphones and tablets and interact with forms.

Implications for IT

Most organizations aren't leveraging the full power of PDF today, and this is a missed opportunity. Information workers need strong PDF tools along with training, support, and best practices, and we believe this is an area where IT can have a significant impact on information worker productivity at minimal cost to the organization.

Most organizations aren't leveraging the full power of PDF today, and this is a missed opportunity where IT can help. Information workers need strong PDF tools along with training, support, and best practices.

First, IT needs to ensure users have basic PDF capabilities. As noted previously, more than a third of information workers in Western Europe voice frustration that others are often unable to open, view, or print their documents. This is a problem the PDF standard has addressed since inception, and yet PDF users struggle just as much with this as non-PDF users. Why has this problem persisted? IT certainly appreciates the benefits PDF brings in regard to document distribution: 68.2% of IT respondents in Western Europe agree that a key benefit of PDF is document portability across all their devices (especially mobile). As the saying goes, however, "the devil is in the details," and PDF creation tools are not all created equal. IT can help by rigorously evaluating PDF software tools to ensure they produce high-quality PDF files with full fidelity across all devices.

Then, IT should explore how advanced PDF software can improve information worker productivity. Too often, use of PDF begins and ends with document distribution. Advanced PDF software can help improve information worker productivity in three key areas: document creation and management (personal productivity), document edit/review/approval (collaboration), and mobility.

CONCLUSION AND RECOMMENDATIONS

In the past, IT has focused plenty of attention on providing users a variety of real-time and asynchronous collaborative tools that make it easier to connect with others electronically and work across geographical, time zone, and organizational boundaries. These solutions are essential to the way we work today: It would be difficult to imagine returning to a world without email and calendaring, Web conferencing, and so forth.

IT has focused plenty of attention on providing real-time and asynchronous collaborative tools. These solutions are essential to the way we work today, but they aren't enough.

But these technologies don't address many of the information worker's needs and challenges related to working with documents. As our research shows, some of these challenges arise as information workers work independently on document creation

and management activities; others are related to document collaboration. In addition, information workers need to be able to work with documents on their mobile devices. IT should engage with users to prioritize the most significant document-oriented challenges for their organization and address them with specific remedies.

The potential payback is enormous: As our study shows, a significant percentage of an information worker's time is wasted, at a cost of €14,492 per information worker per year in Western Europe. Just as IT organizations are looking to increase the percentage of the budget that is tied to innovation (as opposed to "keep the lights on" activities), organizations need to reexamine how information workers spend their time and look for ways to shift a greater percentage of it to real value creation. Recovering lost information worker productivity would enable organizations to invest more of their existing resources in sales, support, product development, and market development.

Organizations need to reexamine how information workers spend their time and look for ways to shift a greater percentage of it to real value creation.

As IT embarks on its assessment of the current state of information work in the organization, it should keep in mind the following:

- IT should investigate solutions — such as advanced PDF software — that make it easier to work with documents and address the information worker productivity challenges we have discussed in this paper. These solutions complement the organization's existing investments in collaborative applications, and the cost of the additional tooling can be modest. Where PDF is already in use, IT should assess how effectively it's being used because implementations of the standard vary in completeness and quality.

IT should investigate solutions — such as advanced PDF software — that make it easier to work with documents and address the information worker productivity challenges we have discussed in this paper.

- IT needs to rethink information worker productivity in the context of the industrywide shift under way to what IDC calls the 3rd platform — that is, an IT infrastructure that leverages cloud, mobile, social, and big data technologies. IT needs to become an enabler of mobile information work, and it should proactively investigate SaaS solutions for external collaboration, which — as we have seen — is an important and nearly universal requirement of information work today.

- Because information work involves a significant amount of external collaboration, the tools and best practices that IT provides must, at the same time, address the security concerns that arise when documents are shared with people outside the firewall. This requires adoption of document-based tools and best practices that minimize the chance of information leaks, which are already a problem in many organizations.

IT must also address the security concerns that arise when documents are shared with people outside the firewall.

Adopting document-based tools and best practices can minimize the chance of information leaks.

- IT needs to significantly improve its desktop management practices — both to reduce its exposure to security threats and to reduce the amount of time it spends dealing with administrative (keep the lights on) tasks. This will become increasingly important as the number and the variety of devices that are attached to the enterprise network continue to grow and as IT is called upon to manage and secure information that lives in the cloud, on premise, or in hybrid environments.

Above all, IT should begin with a gap analysis. The organization's information workers will be the best source of insight and inspiration when it comes to prioritizing needed improvements. The first step is closing the perception gaps between information workers and IT.

APPENDIX

Methodology

The information for this white paper came from a global survey of 1,200 information workers and IT professionals in the United States, the United Kingdom, France, Germany, Australia, and Japan conducted in June 2012. We surveyed both information workers (n = 840) and IT professionals (n = 360) across a broad range of industries and company sizes (we screened for companies that have at least 50 employees who have dedicated PCs). Respondents were randomly recruited from international panels, and the survey was conducted over the Internet in local languages. We recruited 200 respondents per country, including 140 information workers, 30 IT management, and 30 IT staff. Data was not weighted.

For the purposes of our study, we defined an information worker as a full-time (non-IT) employee who is connected to the Internet and uses a computer to work with documents on a weekly basis as part of his or her job. Working with documents includes activities such as creating documents; sending documents around for review, approvals, and signatures; creating forms to gather data and filling in forms; and reviewing, approving, and signing documents that others send out. Our information worker respondents represented a good mix of functional areas, and 62% of them were managers or above.

IT management included IT executives, vice presidents, and directors (also managers in Japan) who have decision-making authority over or are involved in evaluating and/or making recommendations in regard to their organization's desktop productivity software.

IT staff included managers, supervisors, and others who are directly involved in the evaluation/selection, testing, support, or deployment of their organization's desktop productivity software.

We asked information worker respondents detailed questions about the time they spend each week on a variety of document-oriented activities; the time they spend dealing with various challenges working with documents; their frustrations and needs in this regard; who they collaborate with; and their needs related to mobility.

We asked IT respondents detailed questions about IT's priorities, key concerns, and current practices related to desktop software evaluation and deployment; support for mobile information workers and BYOD initiatives; current and planned adoption of SaaS information worker applications; support for external collaboration; and attitudes about document and application security.

Information Worker Productivity Cost Calculations

To calculate the cost of lost productivity for an information worker, we multiply the percentage of time wasted by average annual compensation:

- Information workers in Western Europe say they work 44.3 hours per week, but when they were asked to break down their workweek into the activities listed in Figure 1, the number of hours totaled 47.1. This has been a common response pattern in all of IDC's Hidden Costs of Information Work surveys over the past decade: When information workers are asked about time spent by activity, the total invariably exceeds the number of hours the respondents say they spend at work each week. Although this may be the result of some perceived (though unintended) overlap in our list of activities, we think it's indicative of the fact employees generally aren't asked to perform task-based time accounting (when they are, it's not using our specific list of activities; there are no industry standards here). Our calculations of the percentage of time wasted are all based on the higher figure (47.1) to be conservative.

- Our estimates of the percentage of time spent dealing with frustrations (refer back to Figure 2) that should be considered wasted time are based on a decade of information worker productivity research, and we believe the estimates are conservative (refer back to Tables 1 and 2). The potential for increased productivity will be higher in many organizations.

- Cost calculations assume an average annual compensation of €60,000, including benefits and payroll-related costs (see www.statistics.gov.uk and epp.eurostat.ec.europa.eu). These exclude other fixed per-employee costs such as office space, equipment, management time, and so forth to be conservative.

To calculate the impact of lost information worker productivity on the organization as a whole, we multiply information worker productivity costs by the percentage of employees who are information workers:

- According to IT respondents in Western Europe, 80.6% of their employees have dedicated PCs (the percentage ranges from 78% in Australia to 84.2% in the United States); hence they are likely to be information workers by our definition. This means improving the productivity of the organization's information workers by 10% is equivalent to increasing the overall organization's productivity by 8.06%.

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- C. T. Meadow and D. W. Waugh, "Computer assisted interrogation," in *1991 Fall Joint Computer Conf., Proc. AFIPS Conf.*, vol. 29. Washington, DC, USA: Spartan, 1991, pp. 381–394.
- P. C. Parks, "Lyapunov redesign of model reference adaptive control systems," in *1993 Joint Automatic Control Conf., Preprints*, pp. 485–491.
- T. S. Hsia, "System identification," in *IEDM Tech. Dig.*, 1993, vol. 2, no. 8, pp. 6–13.

Conference Proceedings With DOI

Basic Format:

- J. K. Author, "Title of paper," in *Abbreviated Name of Conf.*, (location of conference is optional), year, pp. *xxx–xxx*, doi: *xxx.*

Examples:

- G. Veruggio, "The EURON roboethics roadmap," in *Proc. Humanoids '06: 6th IEEE-RAS Int. Conf. Humanoid Robots*, 2006, pp. 612–617, doi: 10.1109/ICHR.2006.321337.
- J. Zhao, G. Sun, G. H. Loh, and Y. Xie, "Energy-efficient GPU design with reconfigurable in-package graphics

memory," in *Proc. ACM/IEEE Int. Symp. Low Power Electron. Design (ISLPED)*, Jul. 2012, pp. 403–408, doi: 10.1145/2333660.2333752.

Conference Proceedings With Editors

Basic Format:

- J. K. Author, "Title of paper," in *Abbreviated Name of Conf.*, X. Editor, Ed. (location of conference is optional), year, pp. *xxx-xxx.*

Examples:

- A. Amador-Perez and R. A. Rodriguez-Solis, "Analysis of a CPW-fed annular slot ring antenna using DOE," in *Proc. IEEE Antennas Propag. Soc. Int. Symp.*, A. Amador-Perez and R. A. Rodriguez-Solis, Eds. Jul. 2006, pp. 4301–4304.
- D. B. Armstrong, G. J. Fogarty, and D. Dingsdag, "Scales measuring characteristics of small business information systems," in *Proc. Res., Relevance Rigour: Coming of Age: 18th Australasian Conf. Inf. Syst.*, W-G. Tan, Ed. 2007, pp. 163–171.
- P. Funes, B. Orme, and E. Bonabeau, "Evolving emergent group behaviors for simple human agents," in *Proc. 7th Eur. Conf. Artif. Life*, P. Dittrich and J. T. Kim, Eds. Sep. 2003, pp. 76–89.

Conference Proceedings With Location

Basic Format:

- J. K. Author, "Title of paper," in *Abbreviated Name of Conf.*, City, State, Country, year, pp. *xxx–xxx.*

Examples:

- L. S. Carmichael, N. Ghani, P. K. Rajan, K. O'Donoghue, and R. Holt, "Characterization and comparison of modern layer-2 Ethernet survivability protocols," in *Proc. 37th Southeastern Symp. Syst. Theory (SSST 2005)*, Tuskegee, AL, USA, Mar. 20–22, 2005, pp. 124–129.
- D. Sarkar and K. V. Srivastava, "SRR-loaded antipodal Vivaldi antenna for UWB applications with tunable notch function," in *Proc. Int. Symp. Electromagn. Theory*, Hiroshima, Japan, 2013, pp. 466–469.

Conference Proceedings With Series Title, Volume Title, and Edition

Basic Format:

- J. K. Author, "Title of paper," in *Abbreviated Name of Conf.* in Volume Title, in Series Title, ed., year, pp. *xxx-xxx.*

Example:

- A. Amador-Perez and R. A. Rodriguez-Solis, "Analysis of a CPW-fed annular slot ring antenna using DOE," in *Proc. IEEE Antennas Propag. Soc. Int. Symp.*, in Slot Ring Antennas II, vol. 3, 2nd ed., Jul. 2006, pp. 4301–4304.

Conference Paper Online

Basic Format:

- J. K. Author. (Date). Title. Presented at Abbreviated Conf. title. [Type of Medium]. Available: site/path/file

Examples:

- Process Software Corp., Framingham, MA, USA. Intranets: Internet technologies deployed behind the firewall for corporate productivity. Presented at INET'96 Annu. Meeting. [Online]. Available: http://www.process.com/Intranets/wp2.htp
- J. A. Taylor. (Nov. 2006). Assessment: A tool for development and engagement in the first year of university study. Presented at Engaging Students: 9th Pacific Rim in Higher Education (FYHE) Conf., Griffith, Australia. [Online]. Available: http://www.fyhe.com.au/past_papers/2006/Papers/Taylor.pdf
- V. Chandrasekaran, S. Sanghavi, P. A. Parrilo, and A. S. Willsky. (2009). Sparse and low-rank matrix decompositions. Presented at IFAC 2009. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S1474667016388632

Conference Proceedings Online

Basic Format:

- J. K. Author, "Title of paper," in *Abbreviated Name of Conf.*, (location of conference is optional), year, pp. *xxx-xxx*. [Online]. Available: http://www.url.com

Examples:

- T. Schubert, "Real challenges and solutions for validating system-on-chip high level formal verification of next-generation microprocessors," in *Proc. 40th Design Automation Conf. (DAC'03)*, Jun. 2–6, 2003. [Online]. Available: http://www.computer.org/csdl/proceedings/dac/2003/2394/00/2394001-abs.html
- J. Yanamadala *et al.*, "Segmentation of the visible human project (VHP) female cryosection images within MATLAB environment," in *Proc. 23rd Int. Meshing Roundtable*, London, U.K., Oct. 2014. [Online]. Available: http://www.imr.sandia.gov/papers/imr23.htm

C. Course

Basic Format:

Name of University. (Year). Title of course. [Online]. Available: URL

Example:

- Argosy University Online. (2012). Information literacy and communication. [Online]. Available: http://www.myeclassonline.com

Coursepack

Basic Format:

- J. K. Instructor. Title of coursepack. (Semester). Title of course. University/Publisher location: University/Publisher name.

Example:

- Q. Oden. Mud and Bones – Geology Coursepack. (2014, Winter). GEOG 042. Cranbrook, Canada: College of the Rockies

D. Datasets

The essential components of a citation to a dataset are the following: Author names of each individual or organizational entity responsible for the creation of the dataset; the complete title of the dataset, including the edition or version number, if applicable; the date published or disseminated [year and full date (if available)]; publisher and/or distributor; and electronic location or identifier (URL or DOI if applicable). Append the date retrieved if the title and locator are not specific to the exact instance of the data you used.

Basic Format:

- Author, "Title." (Date, Year). Distributed by Publisher/Distributor. http://url.com (or if DOI is used, end with a period)

Example:

- S. Ansolabehere, M. Palmer, and A. Lee. "Precinct-level election data. V1." January 20, 2014. Distributed by Harvard Election Data Archive. http://hdl.handle.net/1902.1/21919 UNF:5:5C9UfGjdLy2ONVPtgr45qA==

Online Dataset Reference Using a DOI

Basic Format:

- *Title*, Source, Date, doi: *xxx.*

Example:

- *Treatment episode dataset: Discharges (TEDS-D): Concatenated, 2006 to 2009*, U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Office of Applied Studies, Aug. 2013, doi: 10.3886/ICPSR30122.v2.

Online Dataset Reference Using a DOI Resolver

Basic Format:

- *Title*, Source, Date, doi: URL.

Example:

- *Treatment episode dataset: Discharges (TEDS-D): Concatenated, 2006 to 2009*, U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Office of Applied Studies, Aug. 2013, doi: http://dx.doi.org/10.3886/ICPSR30122.v2.

Online Dataset Reference Using a Website Address

Basic Format:

- *Title*, Source, Date. [Online]. Available: http://www.url.com

Example:

- *Treatment episode dataset: Discharges (TEDS-D): Concatenated, 2006 to 2009*, U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Office of Applied Studies, Aug. 2013. [Online]. Available: http://www.icpsr.umich.edu/icpsrweb/SAMHDA/studies/30122/version/2

E. Handbooks

Basic Format:

- *Name of Manual/Handbook*, *x* ed., Abbrev. Name of Co., City of Co., Abbrev. State, year, pp. *xxx-xxx.*

Examples:

- *Transmission Systems for Communications*, 3rd ed., Western Electric Co., Winston-Salem, NC, USA,1985, pp. 44–60.
- *Motorola Semiconductor Data Manual*, Motorola Semiconductor Products Inc., Phoenix, AZ, USA,1989.
- *RCA Receiving Tube Manual*, Radio Corp. of America, Electronic Components and Devices, Harrison, NJ, Tech. Ser. RC-23, 1992.

F. Lectures

Lecture Notes

Basic Format:

- J. K. Author. (Year). Title of lecture [Type of Medium]. Available: URL

Examples:

- J. Barney. (2011). Documenting literature [PowerPoint slides]. Available: http://moodle.cotr/english/gill
- Z. Yardish. Tumbling past data [Online]. Available: http://www.statistics.cotr.ca/classes/statistics/Yardish/index.html

Lecture Online

Basic Format:

- University name. (year). Title of lecture. [Type of Medium]. Available: URL

Example:

- Argosy University Online. (2012). Information literacy and communication: Module 2 filing and organization. [Online]. Available: http://www.myeclassonline.com

G. Manuals/Software

Basic Format:

- J. K. Author (or Abbrev. Name of Co., City of Co. Abbrev. State, Country). *Name of Manual/Handbook, x* ed. (year). Accessed: Date. [Online]. Available: http://www.url.com

Examples:

- L. Breimann. *Manual on Setting Up, Using, and Understanding Random Forests v4.0*. (2003). Accessed: Apr. 16, 2014. [Online]. Available: http://oz.berkeley.edu/users/breiman/Using_random_forests_v4.0.pdf
- M. Kuhn. *The Caret Package*. (2012). [Online]. Available: http://cranr-project.org/web/packages/caret/caret.pdf
- Antcom, Torrance, CA, USA. *Antenna Products.* (2011). Accessed: Feb. 12, 2014. [Online]. Available: http://www.antcom.com/documents/catalogs /L1L2GPSAntennas.pdf

Manual (Print)

Basic Format:

- *Name of Manual/Handbook, x* ed., Abbrev. Name of Co., City of Co., Abbrev. State, Country, year, pp. *xxx–xxx.*

Examples:

- *Transmission Systems for Communications*, 3rd ed., Western Electric Co., Winston-Salem, NC, USA,1985, pp. 44–60.
- *Motorola Semiconductor Data Manual*, Motorola Semiconductor Products Inc., Phoenix, AZ, USA,1989.
- *RCA Receiving Tube Manual*, Radio Corp. of America, Electronic Components and Devices, Harrison, NJ, USA, Tech. Ser. RC23, 1992.
- *Microsoft Office 97 Visual Basic Programmer's Guide, Microsoft Professional Editions Series*, Microsoft, Redmond, WA, USA, 1997.

Manual (Online)

Basic Format:

- J. K. Author (or Abbrev. Name of Co., City of Co. Abbrev. State, Country). *Name of Manual/Handbook, x* ed. (year). Accessed: Date. [Online]. Available: http://www.url.com

Examples:

- L. Breimann. *Manual on Setting Up, Using, and Understanding Random Forests v4.0*. (2003). Accessed: Apr. 16, 2014. [Online]. Available: http://oz.berkeley.edu/users/breiman/Using_random_forests_v4.0.pdf
- M. Kuhn. *The Caret Package.* (2012). [Online]. Available: http://cranr-project.org/web/packages/caret/caret.pdf

Software

Basic Format:

- *Title of Software.* (version or year), Publisher Name. Accessed: Date (when applicable). [Type of Medium]. Available: site/path/file

Examples:

- *Antenna Products*. (2011). Antcom. Accessed: Feb. 12, 2014. [Online]. Available: http://www.antcom.com/documents/catalogs/L1L2GPSAntennas.pdf
- *Ngspice*. (2011). [Online]. Available: http://ngspice.sourceforge.net
- *MSDN Library Visual Studio 6.0*. (2001). Microsoft.

H. Online Video (e.g., YouTube)

Format: Video Owner/Creator, Location (if available). *Title of Video: In Initial Caps.* (Release date). Accessed: Month Day, Year. [Online Video]. Available: http://URL.onlinevideo.org

mtaOnline1, Fazi Mosque, U.K. An Occasionally Accurate History of Australia: Part I. (Oct. 23, 2006). Accessed: Oct. 6, 2010. [Online Video]. Available: http://www.youtube.com/watch?v=IJjNsCVHc34

Doane Academy, Burlington, NJ, USA. Second Grade Bossy R. (Feb. 28, 2013). Accessed: Jun. 3, 2018. [Online Video]. Available: https://www.youtube.com/watch?v=PUKHo1Y-BcM

I. Patent

Retain or request the day of the month when referencing a patent.

NOTE: Use "issued date" if several dates are given.

Basic Format:

- J. K. Author, "Title of patent," U.S. Patent *x xxx xxx,* Abbrev. Month, day, year.
- J. K. Author, "Title of patent," Country Patent *xxx,* Abbrev. Month, day, year.

Examples:

- J. P. Wilkinson, "Nonlinear resonant circuit devices," U.S. Patent 3 624 125, Jul. 16, 1990.
- T. Mei and T. Yang, "Circuit and method for average–current regulation of light-emitting diodes," U.S. Patent 7 898 187 B1, 2011, Mar. 1, 2012.
- W. W. Black and A. Clavin, "Dipole augmented slot radiating element," U.S. Patent 3594806, Jul. 1971.
- S. P. Voinigescu *et al*., Direct *m*-ary quadrature amplitude modulation (QAM) operating in saturated power mode," U.S. Patent Appl. 20110013726A1, Jan. 20, 2011.
- K. Klionovski, "Broadband dual-band microstrip antenna," (in Russian), RU Patent Utility Model 167296, Dec. 27, 2016.

Patent Online

Basic Format:

- Name of the invention, by inventor's name. (year, month day). Patent Number [Type of medium]. Available: site/path/file

Examples:

- Musical toothbrush with adjustable neck and mirror, by L. M. R. Brooks. (1992, May 19). Patent D 326 189 [Online]. Available: NEXIS Library: LEXPAT File: DESIGN
- Screwless clip mounted computer drive, by D. Williams. (2005, Apr. 26). U.S. Patent 6,885,550 [Online]. Available: http://patft.uspto.gov/netacgi/6,885,550

J. Periodicals

Periodicals

Prior to 1988, the volume number of IEEE Transactions/Journals carried the acronym of the journal. For example, an issue of the IEEE TRANSACTIONS ON AUTOMATIC CONTROL would read: *IEEE Trans. Automat. Contr.*, vol. AC-26, no. 1, pp. 1–34, Jan. 1981. When referencing IEEE Transactions, both the issue number and month are included

upon verification of frequency and starting month. DOIs are included, when provided by the author.

NOTE: The only exception to this rule is PROCEEDINGS OF THE IEEE, which never carried an acronym on the masthead.

Basic Format:

- J. K. Author, "Name of paper," *Abbrev. Title of Periodical*, vol. *x*, no. *x*, pp. *xxx-xxx*, Abbrev. Month, year.
- J. K. Author, "Name of paper," *Abbrev. Title of Periodical*, vol. *x*, no. *x*, pp. *xxx-xxx*, Abbrev. Month, year, doi: *xxx*.

Examples:

- M. M. Chiampi and L. L. Zilberti, "Induction of electric field in human bodies moving near MRI: An efficient BEM computational procedure," *IEEE Trans. Biomed. Eng.*, vol. 58, pp. 2787–2793, Oct. 2011, doi: 10.1109/TBME.2011.2158315.
- M. Ito *et al*., "Application of amorphous oxide TFT to electrophoretic display," *J. Non-Cryst. Solids*, vol. 354, no. 19, pp. 2777–2782, Feb. 2008.
- R. Fardel, M. Nagel, F. Nuesch, T. Lippert, and A. Wokaun, "Fabrication of organic light emitting diode pixels by laser-assisted forward transfer," *Appl. Phys. Lett.*, vol. 91, no. 6, Aug. 2007, Art. no. 061103.
- J. Zhang and N. Tansu, "Optical gain and laser characteristics of InGaN quantum wells on ternary InGaN substrates," *IEEE Photon. J*., vol. 5, no. 2, Apr. 2013, Art no. 2600111.
- S. Preu, G.H.Döhler, S.Malzer, L.J.Wang, and A. C. Gossard,"Tunable continuous-wave terahertz photo mixer sources and applications," *J. Appl. Phys*., vol. 109, Mar. 2011, Art. no. 061301.
- S. Azodolmolky *et al*., Experimental demonstration of an impairment aware network planning and operation tool for transparent/translucent optical networks," *J. Lightw. Technol*., vol. 29, no. 4, pp. 439–448, Sep. 2011.
- H. Eriksson and P. E. Danielsson, "Two problems on Boolean memories," *IEEE Trans. Electron. Devices*, vol. ED-11, no. 1, pp. 32–33, Jan. 1959.
- F. Aronowitz, "Theory of traveling-wave optical maser," *Phys. Rev.*, vol. 134, pp. A635–A646, Dec. 8, 1965.
- Ye. V. Lavrova, "Geographic distribution of ionospheric disturbances in the F2 layer," *Tr. IZMIRAN*, vol. 19, no. 29, pp. 31–43, 1961 (Transl.: E. R. Hope, Directorate of Scientific Information Services, Defence Research Board of Canada, Rep. T384R, Apr. 1963).
- E. P. Wigner, "On a modification of the Rayleigh–Schrodinger perturbation theory," (in German), *Math. Naturwiss. Anz. Ungar. Akad. Wiss.*, vol. 53, p. 475, 1935.
- E. H. Miller, "A note on reflector arrays," *IEEE Trans. Antennas Propag.*, to be published.*** *Always use this style when the paper has been accepted or scheduled for a future publication, i.e., do not use "to appear in."****
- C. K. Kim, "Effect of gamma rays on plasma," submitted for publication. *** *Always use this style when the paper has not yet been accepted or scheduled for publication, i.e., do not use "to appear in."****
- W. Rafferty, "Ground antennas in NASA's deep space telecommunications," *Proc. IEEE,* vol. 82, no. 5, pp. 636-640, May 1994.
- P. Kopyt *et al., "*Electric properties of graphene-based conductive layers from DC up to terahertz range," *IEEE THz Sci. Technol.*, to be published. doi: 10.1109/TTHZ.2016.2544142.
- T. Brunschwiler *et al*., "Formulation of percolating thermal underfills using hierarchical self-assembly of microparticles and nanoparticles by centrifugal forces and capillary bridging," *J. Microelectron. Electron. Packag.*, vol. 9, no. 4, pp. 149–159, 2012, doi: 10.4071/imaps.357.
- L. T. Wu *et al.*, "Real-time analytic sensitivity method for transient security assessment and prevent control," *Proc. Inst. Elect. Eng.*, vol. 135, pt. C, pp. 107-117, Mar. 1988.
  ****Authors may refer to this journal as Proc. IEE, but the abbreviation must be as listed above. Proc. IEE is printed in the U.K. and must not be confused with the Proc. IEEE.****
- *Special Issue on Artificial Neural Network Applications*, *Proc. IEEE*, vol. 84, pp. 1353-1576, Oct. 1996.

Article Referred to in the Same Issue:

- R. U. Aslip, "Surface and leaky wave antennas," *IEEE Trans. Circuits Syst. I, Fundam. Theory Appl.*, vol. 30, no.1, pp. 545–546, Jan. 2000.

NOTE: Handle it exactly as any other reference with no difference.

Periodical With Article ID

Basic Format:

- J. K. Author, "Name of paper," *Abbrev. Title of Periodical*, vol. *x*, no. *x*, Abbrev. month, year, Art. no. *xxx*.

Examples:

- J. Zhang and N. Tansu, "Optical gain and laser characteristics of InGaN quantum wells on ternary InGaN substrates," *IEEE Photon. J.*, vol. 5, no. 2, Apr. 2013, Art no. 2600111.
- R. Fardel, M. Nagel, F. Nuesch, T. Lippert, and A. Wokaun, "Fabrication of organic light emitting diode pixels by laser-assisted forward transfer," *Appl. Phys. Lett.*, vol. 91, no. 6, Aug. 2007, Art. no. 061103.
- S. Preu, G. H. Döhler, S. Malzer, L. J. Wang, and A. C. Gossard, "Tunable continuous-wave terahertz photo mixer sources and applications," *J. Appl. Phys.*, vol. 109, Mar. 2011, Art. no. 061301.
- L. Kuang *et al.*, "A numerical method for analyzing electromagnetic scattering properties of a moving conducting object," *Int. J. Antennas Propag.*, vol. 2014, 2014, Art. no. 386315, doi: 10.1155/2014/386315.

Periodical With DOI

Basic Format:

- J. K. Author, "Name of paper," *Abbrev. Title of Periodical*, vol. *x*, no. *x*, pp. *xxx–xxx*, Abbrev. month, year, doi: *xxx*.

Example:

- M. M. Chiampi and L. L. Zilberti, "Induction of electric field in human bodies moving near MRI: An efficient BEM computational procedure," *IEEE Trans. Biomed. Eng.*, vol. 58, no. 10, pp. 2787–2793, Oct. 2011, doi: 10.1109/TBME.2011.2158315.

Periodical in Other Language

Basic Format:

- J. K. Author, "Name of paper," (in Language), *Abbrev. Title of Periodical*, vol. *x*, no. *x*, Abbrev. month, year, Art. no. *xxx*.

Examples:

- E. P. Wigner, "On a modification of the Rayleigh–Schrodinger perturbation theory," (in German), *Math. Naturwiss. Anz. Ungar. Akad. Wiss.*, vol. 53, p. 475, 1935.
- Y. V. Lavrova, "Geographic distribution of ionospheric disturbances in the F2 layer," *Tr. IZMIRAN*, vol. 19, no. 29, pp. 31–43, 1961 (Transl.: E. R. Hope, Directorate of Scientific Information Services, Defence Research Board of Canada, Rep. T384R, Apr. 1963).

Periodicals Online

Basic Format:

- J. K. Author, "Name of paper," *Abbrev. Title of Periodical*, vol. x, no. x, pp. xxx–xxx, Abbrev. Month, year. Accessed: Month, Day, Year, doi: 10.1109.XXX.123456. [Online]. Available: site/path/file

Examples:

- W. P. Risk, G. S. Kino, and H. J. Shaw, "Fiber-optic frequency shifter using a surface acoustic wave incident at an oblique angle," *Opt. Lett.*, vol. 11, no. 2, pp. 115–117, Feb. 1986. [Online]. Available: http://ol.osa.org/abstract.cfm?URI=ol-11-2-115
- P. Kopyt et al., "Electric properties of graphene-based conductive layers from DC up to terahertz range," *IEEE THz Sci. Technol.*, to be published, doi: 10.1109/TTHZ.2016.2544142.

Virtual Journal

Basic Format:

- Name(s) of Ed(s)., "Title of Issue," in *Title of Journal*, Abbrev. month year. [Online]. Available: URL

Examples:

- J. Smith, T. Jones, and B. Simpson, Eds., "IEEE Biometrics Compendium Issue 30 December 2017," in *IEEE Biometrics Compendium*, Dec. 2017. [Online]. Available: http://ieeexplore.ieee.org/virtual-journals/biocomp/issue/30/
- T. Robertson, Ed., "RFIC Virtual Journal–Issue 6," in *IEEE RFIC Virtual Journal*, Oct. 2014. [Online]. Available: http://ieeexplore.ieee.org/virtual-journals/rfic/issue/6/
- "RFID Virtual Journal–Issue 10," in *IEEE RFID Virtual Journal*, Nov. 2015. [Online]. Available: http://ieeexplore.ieee.org/virtual-journals/rfid/issue/10/

K. Reports

The general form for citing technical reports is to place the name and location of the company or institution after the author and title and to give the report number and date at the end of the reference.

Basic Format:

- J. K. Author, "Title of report," Abbrev. Name of Co., City of Co., Abbrev. State, Country, Rep. *xxx*, year.

Examples:

- E. E. Reber, R. L. Michell, and C. J. Carter, "Oxygen absorption in the earth's atmosphere," Aerospace Corp., Los Angeles, CA, USA,Tech. Rep. TR-0200 (4230-46)-3, Nov. 1988.
- J. H. Davis and J. R. Cogdell, "Calibration program for the 16-foot antenna," Elect. Eng. Res. Lab., Univ. Texas, Austin, Tech. Memo. NGL-006-69-3, Nov. 15, 1987.
- R. E. Haskell and C. T. Case, "Transient signal propagation in lossless isotropic plasmas," USAF Cambridge Res. Labs., Cambridge, MA, USA, Rep. ARCRL-66-234 (II), 1994, vol. 2.
- M. A. Brusberg and E. N. Clark, "Installation, operation, and data evaluation of an oblique-incidence ionosphere sounder system," in "Radio Propagation Characteristics of the Washington-Honolulu Path," Stanford Res. Inst., Stanford, CA, USA, Contract NOBSR-87615, Final Rep., Feb. 1995, vol. 1.
- P. Diament, S. L. Richert, and W. L. Lupatkin, "V-line surface-wave radiation and scanning," Dept. Elect. Eng., Columbia Univ., New York, NY, USA, Sci. Rep. 85, Aug. 1991.

Report Online

Ensure a year is included and add the URL to the end of the reference.

Basic Format:

- J. K. Author, "Title of report," Company, City, State, Country, Rep. no., (optional: vol./issue), Date. Accessed: Date. [Online]. Available: site/path/file

Examples:

- R. J. Hijmans and J. van Etten, "Raster: Geographic analysis and modeling with raster data," R Package Version 2.0-12, Jan. 12, 2012. [Online]. Available: http://CRAN.R-project.org/package=raster
- "Teralyzer," Lytera UG, Kirchhain, Germany. Accessed: Jun. 5, 2014. [Online]. Available: http://www.lytera.de/Terahertz_THz_Spectroscopy.php?id=home
- F. Zhao, "Smartphone solutions white paper," Shenzhen, China, Huawei, White Paper, 2012. [Online]. Available: http://www.huawei.com/ilink/en/download/HW_193034
- Bureau of Meteorology, "Bureau of Meteorology: Measuring Rainfall in Australia," 2009. [Online]. Available: http://www.bom.gov.au/climate/cdo/about/definitionsrain.shtml#meanrainfall
- GeoBasisNRW HYPERLINK "http://ol.osa.org/abstract.cfm?URI=ol-11-2-115", "ATKIS—Digitale Topographische Karte 1:25.000 (DTK25)," Bezirksregierung Köln, Cologne, Germany, 2012. [Online]. Available: http://www.bezreg-koeln.nrw.de/brkinternet/presse/publikationen/geobasis/fal HYPERLINK "http://ol.osa.org/abstract.cfm?URI=ol-11-2-115"tblatt_geobasis_ HYPERLINK

"http://ol.osa.org/abstract.cfm?URI=ol-11-2-115"atkis01.pdf

- K. Kagaku, "Multipurpose chest phantom: Lungman." Accessed: Apr. 17, 2014. [Online]. Available: http://www.kyotokagaku.com/products/detail03/pdf/ph-1_catalog.pdf
- "Apple iPhone," Apple Inc., Palo Alto, CA, USA. Accessed: Feb. 25, 2013. [Online]. Available: http://apple.com/iphone/
- S. Urazhdin, N. O. Birge, W. P. Pratt Jr., and J. Bass, "Current-driven magnetic excitations in permalloy-based multilayer nanopillars," 2003. [Online]. Available: arXiv:cond-mat/0303149.

L. Standards

Basic Format:

- *Title of Standard*, Standard number, Corporate author, location, date.
- *Title of Standard*, Standard number, date.

Examples:

- *Parameter Values for Ultra-High Definition Television Systems for* Switzerland, *Production and International Programme Exchange*, Rec. ITU-R BT.2020-2, International Telecommunications Union, Geneva, Switzerland, Oct. 2015.
- *IEEE Criteria for Class IE Electric Systems*, IEEE Standard 308, 1969.
- *Letter Symbols for Quantities*, ANSI Standard Y10.5-1968.

Standard Online

Basic Format:

- *Title of Standard*, Standard number, Corporate author, location, date. [Online]. Available: http://www.url.com
- *Title of Standard*, Standard number, date. [Online]. Available: http://www.url.com

Example:

- *Frequency Response and Bias*, NERC Reliability Standard BAL-003-0.1b, May 2009. [Online]. Available: http://www.nerc.com/files/BAL-003-0_1b.pdf

M. Theses (B.S., M.S.) and Dissertations (Ph.D.)

Basic Format:

- J. K. Author, "Title of thesis," M.S. thesis, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.
- J. K. Author, "Title of dissertation," Ph.D. dissertation, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, year.

Examples:

- J. O. Williams, "Narrow-band analyzer," Ph.D. dissertation, Dept. Elect. Eng., Harvard Univ., Cambridge, MA, USA, 1993.
- N. Kawasaki, "Parametric study of thermal and chemical nonequilibrium nozzle flow," M.S. thesis, Dept. Electron. Eng., Osaka Univ., Osaka, Japan, 1993.
- N. M. Amer, "The effects of homogeneous magnetic fields on developments of tribolium confusum," Ph.D. dissertation, Radiation Lab., Univ. California, Berkeley, Tech. Rep. 16854, 1995. *** *The state abbreviation is omitted if the name of the university includes the state name, i.e., "Univ. California, Berkeley."****
- C. Becle, These de doctoral d'etat, Univ. Grenoble, Grenoble, France, 1968.

Thesis Online

Basic Format:

- J. K. Author, "Title of thesis," M.S. thesis, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, Country,

year. [Online]. Available: http://www.url.com

- J. K. Author, "Title of dissertation," Ph.D. dissertation, Abbrev. Dept., Abbrev. Univ., City of Univ., Abbrev. State, Country, year. [Online]. Available: http://www.url.com

Examples:

- F. Jensen, "Electromagnetic near-field far-field correlations," Ph.D. dissertation, Dept. Elect. Eng., Tech. Univ. Denmark, Lyngby, Denmark, 1970. [Online]. Available: www.tud.ed/jensen/diss
- D. Schwartz, "Development of a computationally efficient full human body finite element model," M.S. thesis, Virginia Tech – Wake Forest Univ. School of Biomed. Eng. Sci., Winston-Salem, NC, USA, 2015. [Online]. Available: https://wakespace.lib.wfu.edu/bitstream/handle/10339/57119/Schwartz_wfu_0248M_10697.pdf

N. U.S. Government Documents

Basic Format:

- Legislative body. Number of Congress, Session. (year, month day). *Number of bill or resolution, Title*. [Type of medium]. Available: site/path/file

Example:

- U.S. House. 102nd Congress, 1st Session. (1991, Jan. 11). *H. Con. Res. 1, Sense of the Congress on Approval of Military Action*. [Online]. Available: LEXIS Library: GENFED File: BILLS

Government Online

Basic Format:

- Legislative body. Number of Congress, Session. (year, month day). *Number of bill or resolution, Title*. [Type of medium]. Available: site/path/file

Example:

- U.S. House. 102nd Congress, 1st Session. (1991, Jan. 11). *H. Con. Res. 1, Sense of the Congress on Approval of Military Action*. [Online]. Available: LEXIS Library: GENFED File: BILLS

O. Unpublished

These are the two most common types of unpublished references.

Basic Format:

- J. K. Author, private communication, Abbrev. Month, year.
- J. K. Author, "Title of paper," unpublished.

Examples:

- A. Harrison, private communication, May 1995.
- B. Smith, "An approach to graphs of linear forms," unpublished.
- A. Brahms, "Representation error for real numbers in binary computer arithmetic," IEEE Computer Group Repository, Paper R-67-85.
- S. Urazhdin, N. O. Birge, W. P. Pratt Jr., and J. Bass, "Current-driven magnetic excitations in permalloy-based multilayer nanopillars," 2003, *arXiv:0303149*.
-

P. Websites

The most basic entry for a website consists of the author name(s), page title, website title, web address, and date

accessed:

First Name Initial(s) Last Name. “Page Title.” Website Title. Web Address (retrieved Date Accessed).

J. Smith. “Obama inaugurated as President.” CNN.com.
http://www.cnn.com/POLITICS/01/21/obama_inaugurated/index.html (accessed Feb. 1, 2009).

The first author’s name should be first initial(s) and then the last name and a period. Titles and affiliations associated with the author should be omitted. A suffix, such as a roman numeral or Jr./Sr., should appear after the author’s given name, preceded by a comma.

For a page with two or more authors, list them in the order as they appear on the website. Separate author names by a comma.

J. Smith and J. Doe. “Obama inaugurated as President.” CNN.com.
http://www.cnn.com/POLITICS/01/21/obama_inaugurated/index.html (accessed Feb. 1, 2009).

Include the web address of the page. Next, place the text “accessed” and the date on which you accessed the website (written in the format of “month day, year”) in parentheses. Conclude the citation with a period after the parentheses.

For informal websites (such as home page or fan websites) or websites without formal titles, use descriptive phrases in your citation in place of page or website titles.

III. NOTES ABOUT ONLINE REFERENCES

The guidelines for citing electronic information as offered here are in modified illustration of the adaptation by the International Standards Organization (ISO) documentation system and the American Psychological Association style.

There are various options for including a URL in a reference. Follow the order of details and whether a period needs to be placed at the end of the reference. The style of the accessed date is “Accessed: Abbrev. month and day, year.” The placement of the accessed date within the reference should match how it is provided in the final author-submitted version.

- Accessed date. [Online]. Available: URL, DOI (add period at end).
- Accessed date. [Online]. Available: URL (no period at end)
- Accessed date, DOI (add period at end).
- URL, DOI (add period at end).
- (no accessed date), DOI (add period at end unless hyperlink).
- URL (no period at end)

Guidelines for Breaking URLs:

- Break after slash or double slash.
- Break “before” the hyphen that is part of an address, but do not break after; do not add hyphens or spaces; do not let addresses hyphenate.
- Break “before” a tilde (~), a hyphen, an underscore (_), a question mark, or a percent (%) symbol.
- Break before or after an equal sign or an ampersand (follow the same rule for the “at” (@) symbol).

IV.USEFUL ABBREVIATIONS IN REFERENCES

A. Common Abbreviations of Words in References

Abstracts	Abstr.		Analysis	Anal.
Academy	Acad.		Annals	Ann.
Accelerator	Accel.		Annual	Annu.
Acoustics	Acoust.		Apparatus	App.
Active	Act.		Applications	Appl.
Administration	Admin.		Applied	Appl.
Administrative	Administ.		Approximate	Approx.
Advanced	Adv.		Archive(s)	Arch.
Aeronautics	Aeronaut.		Artificial	Artif.
Aerospace	Aerosp.		Assembly	Assem.
Affective	Affect.		Association	Assoc.
Africa, African	Afr.		Astronomy	Astron.
Aircraft	Aircr.		Astronautics	Astronaut.
Algebraic	Algebr.		Astrophysics	Astrophys.
American	Amer.		Atmosphere	Atmos.
Atomic, Atoms	At.		Broadcasting	Broadcast.
Australasian	Australas.		Bulletin	Bull.
Australia	Aust.		Bureau	Bur.
Automatic	Autom.		Business	Bus.
Automation	Automat.		Canadian	Can.
Automotive	Automot.		Ceramic	Ceram.
Autonomous	Auton.		Chemical	Chem.
Behavior(al)	Behav.		Chinese	Chin.
Belgian	Belg.		Climatology	Climatol.
Biochemical	Biochem.		Clinical	Clin.
Bioinformatics	Bioinf.		Cognitive	Cogn.
Biology, Biological	Biol.		Colloquium	Colloq.
Biomedical	Biomed.		Communications	Commun.
Biophysics	Biophys.		Compatibility	Compat.
British	Brit.		Component(s)	Compon.
Computational	Comput.		Delivery	Del.
Computer(s)	Comput.		Department	Dept.
Computing	Comput.		Design	Des.
Condensed	Condens.		Detector	Detect.
Conference	Conf.		Development	Develop.
Congress	Congr.		Differential	Differ.
Consumer	Consum.		Digest	Dig.

Conversion	Convers.		Digital	Digit.
Convention	Conv.		Disclosure	Discl.
Correspondence	Corresp.		Discussions	Discuss.
Critical	Crit.		Dissertations	Diss.
Crystal	Cryst.		Distributed	Distrib.
Crystallography	Crystallogr.		Dynamics	Dyn.
Cybernetics	Cybern.		Earthquake	Earthq.
Decision	Decis.		Economic(s)	Econ.
Edition	Ed.		Evolutionary	Evol.
Education	Educ.		Exhibition	Exhib.
Electrical	Elect.		Experimental	Exp.
Electrification	Electrific.		Exploratory	Explor.
Electromagnetic	Electromagn.		Exposition	Expo.
Electroacoustic	Electroacoust.		Express	Express
Electronic	Electron.		Fabrication	Fabr.
Emerging	Emerg.		Faculty	Fac.
Engineering	Eng.		Ferroelectrics	Ferroelect.
Environment	Environ.		Francais, French	Fr.
Equations	Equ.		Frequency	Freq.
Equipment	Equip.		Foundation	Found.
Ergonomics	Ergonom.		Fundamental	Fundam.
European	Eur.		Generation	Gener.
Evaluation	Eval.		Geology	Geol.
Geophysics	Geophys.		Innovation	Innov.
Geoscience	Geosci.		Institute	Inst.
Graphics	Graph.		Instrument	Instrum.
Guidance	Guid.		Instrumentation	Instrum.
Harmonic(s)	Harmon.		Insulation	Insul.
History	Hist.		Integrated	Integr.
Horizon	Horiz.		Intelligence	Intell.
Hungary, Hungarian	Hung.		Intelligent	Intell.
Hydraulics	Hydraul.		Interactions	Interact.
Hydrology	Hydrol.		International	Int.
Illuminating	Illum.		Isotopes	Isot.
Imaging	Imag.		Israel	Isr.
Industrial	Ind.		Japan	Jpn.
Information	Inf.		Journal	J.
Informatics	Inform.		Knowledge	Knowl.
Laboratory(ies)	Lab.		Mathematical	Math.
Language	Lang.		Mathematics	Math.

Learning	Learn.		Measurement	Meas.
Letter(s)	Lett.		Mechanical	Mech.
Lightwave	Lightw.		Medical	Med.
Logic, Logical	Log.		Metals	Met.
Luminescence	Lumin.		Metallurgy	Metall.
Machine	Mach.		Meteorology	Meteorol.
Magazine	Mag.		Metropolitan	Metrop.
Magnetics	Magn.		Mexican, Mexico	Mex.
Management	Manage.		Microelectromechanical	Microelectromech.
Managing	Manag.		Microgravity	Microgr.
Manufacturing	Manuf.		Microscopy	Microsc.
Marine	Mar.		Microwave(s)	Microw.
Material	Mater.		Military	Mil.
Modeling	Model.		Oceanic	Ocean.
Molecular	Mol.		Oceanography	Oceanogr.
Monitoring	Monit.		Occupation	Occupat.
Multiphysics	Multiphys.		Operational	Oper.
Nanobioscience	Nanobiosci.		Optical	Opt.
Nanotechnology	Nanotechnol.		Optics	Opt.
National	Nat.		Optimization	Optim.
Naval	Nav.		Organization	Org.
Network, Networking	Netw.		Packaging	Packag.
Newsletter	Newslett.		Particle	Part.
Nondestructive	Nondestruct.		Patent	Pat.
Nuclear	Nucl.		Performance	Perform.
Numerical	Numer.		Personal	Pers.
Observations	Observ.		Philosophical	Philos.
Photonics	Photon.		Productivity	Productiv.
Photovoltaics	Photovolt.		Programming	Program.
Physics	Phys.		Progress	Prog.
Physiology	Physiol.		Propagation	Propag.
Planetary	Planet.		Psychology	Psychol.
Pneumatics	Pneum.		Quality	Qual.
Pollution	Pollut.		Quarterly	Quart.
Polymer	Polym.		Radiation	Radiat.
Polytechnic	Polytech.		Radiology	Radiol.
Practice	Pract.		Reactor	React.
Precision	Precis.		Receivers	Receiv.
Principles	Princ.		Recognition	Recognit.
Proceedings	Proc.		Record	Rec.
Processing	Process.		Rehabilitation	Rehabil.

Production	Prod.		Reliability	Rel.
Report	Rep.		Semiconductor	Semicond.
Research	Res.		Sensing	Sens.
Resonance	Reson.		Series	Ser.
Resources	Resour.		Simulation	Simul.
Review	Rev.		Singapore	Singap.
Robotics	Robot.		Sistema	Sist.
Royal	Roy.		Society	Soc.
Safety	Saf.		Sociological	Sociol.
Satellite	Satell.		Software	Softw.
Scandinavian	Scand.		Solar	Sol.
Science	Sci.		Soviet	Sov.
Section	Sect.		Spectroscopy	Spectrosc.
Security	Secur.		Spectrum	Spectr.
Seismology	Seismol.		Speculations	Specul.
Selected	Sel.		Statistics	Statist.
Structure	Struct.		Terrestrial	Terr.
Studies	Stud.		Theoretical	Theor.
Superconductivity	Supercond.		Transactions	Trans.
Supplement	Suppl.		Translation	Transl.
Surface	Surf.		Transmission	Transmiss.
Survey	Surv.		Transportation	Transp.
Sustainable	Sustain.		Tutorials	Tut.
Symposium	Symp.		Ultrasonic	Ultrason.
Systems	Syst.		University	Univ.
Technical	Tech.		Vacuum	Vac.
Techniques	Techn.		Vehicular	Veh.
Technology	Technol.		Vibration	Vib.
Telecommunications	Telecommun.		Visual	Vis.
Television	Telev.		Welding	Weld.
Temperature	Temp.		Working	Work.

B. List of Publishers

NOTE: Each publisher's complete title is shown, but do not use what is in parentheses. This is just to show the entire title.

A
Abelard-Schuman (Ltd.), New York, NY, USA
Abingdon (Press), Nashville, TN, USA
Ablex (Publishing Corp.), Norwood, NJ, USA
Harry N. Abrams (Inc.), New York, NY, USA

Academic (Press Inc.), New York, NY, USA; Orlando, FL, USA; San Diego, CA, USA
Ace Books (Inc.), New York, NY, USA
Adam Hilger, New York, NY, USA
Addison-Wesley, Reading, MA, USA
Aegean Park (Press), Laguna Hills, CA, USA
Aiglon (Press, Ltd.), London, U.K.
AIP (American Inst. Phys.), New York, NY, USA
Alden (& Co., Ltd.), Oxford, U.K.
Aldine (Publishing Co.), London, U.K.
Allen & Sons (Ltd.), London, U.K.
G. (George) Allen (& Unwin Ltd.), London, U.K.
H. (Howard) Allen (Inc.), Cleveland, OH, USA
Allenson (& Co., Ltd.), London, U.K.
Allyn & Bacon (Inc.), Boston, MA, USA
American Book (Co.), New York, NY, USA
American Council on Public Affairs, Washington, DC, USA
American Elsevier, New York, NY, USA
American Geographical Soc., New York, NY, USA
American Library Assoc., Chicago, IL, USA
American Management Assoc. (Inc.), New York, NY, USA
American Philosophical Soc., Philadelphia, PA, USA
American Psychological Assoc. (Inc.), Washington, DC, USA
American Technical Soc., Chicago, IL, USA
Amphoto Books (American Photographic Book Publishing Co. Inc.), New York, NY, USA
Antioch (Press), Yellow Springs, OH, USA
Appleton (-Century-Crofts), New York, NY, USA
Architectural Book (Publishing Co., Inc.), New York, NY, USA
Arco (Publishing Co., Inc.), New York, NY, USA
Argus (Books, Inc.), Mohegan Lake, NY, USA
E. (Edward) Arnold (& Co.), London, U.K.
E. J. Arnold (& Sons, Ltd.), London, U.K.
Artech House, Norwood, MA, USA
ASME (American Soc. Mechanical Eng.), New York, NY, USA
Aspen (Publishing, Inc.), Gaithersburg, MD, USA
Associated Press, New York, NY, USA
Athena Scientific, Belmont, MA, USA
Atheneum Press, Boston, MA, USA

Atheneum Press (Ltd.), London, U.K.
Atheneum (Publishers), New York, NY, USA
Atherton (Press), New York, NY, USA
Atlantic Monthly (Press), Boston, MA, USA
Auerbach (Publishing), New York, NY, USA
Augsburg (Publishing House), Minneapolis, MN, USA
(J. J.) Augustin (Inc.), Locust Valley, NY, USA
(N.W.) Ayer (& Sons, Inc.), Philadelphia, PA, USA
B
Babson (Statistical Organization, Inc.), Wellesley Hills, MA, USA
(Karl) Baedeker, Leipzig, Germany
Bailliere (Tindall & Cox, Ltd.), London, U.K.
W. H. Baker (Co.), Boston, MA, USA
Ballentine (Books, Inc.), New York, NY, USA
Bankers (Publishing Co.), Boston, MA, USA
Banta (George Banta Publishing Co. - The Collegiate Press), Menasha, WI, USA
A. S. Barnes (& Co., Inc.), Cranbury, NJ, USA
Barnes & Noble (Inc.), New York, NY, USA
Barren (Educational Series, Inc.), Woodbury, NY, USA
(M.) Barrows (& Co., Inc.), New York, NY, USA
(Johann Ambrosius) Barth, Munich, Germany
Basic Books (Inc.), New York, NY, USA
Battelle (Press), Columbus, OH, USA
Baylor Univ. Press, Waco, TX, USA
Beacon (Press), Boston, MA, USA
G. Bell (& Sons, Ltd.), London, U.K.
J. P. Bell (Co.), Lynchburg, VA, USA
(Matthew) Bender (& Co., Inc.), New York, NY, USA
W. A. Benjamin (Inc.), New York, NY, USA
Benjamin Cummings (Publishing Co.), Redwood City, CA, USA
(Ernest) Benn (Ltd.), London, U.K.
(Charles A.) Bennett (Co.), Peoria, IL, USA
Benziger (Brothers, Inc.), New York, NY, USA
(Librairie Polytechnique Charles) Beranger, Paris, France
Berlinische Verlagsanstalt, Berlin, Germany
Beuth Vertrieb, G.m.b.H., Berlin, Germany

Birkhaüser, Cambridge, MA, USA
A. & C. Black (Ltd.), London, U.K.
(Walter J.) Black (Inc.), Roslyn, NY, USA
Blackie (& Son, Ltd.), Glasgow, U.K.
(Basil) Blackwell (& Mott, Ltd.), Oxford, U.K.
(William) Blackwood (& Sons, Ltd.), Edinburgh, U.K.
Blaisdell, London, U.K.
Blandford (Press. Ltd.), London, U.K.
Blue Ribbon (Books, Inc.) New York, NY, USA
(Clark) Boardman (Co., Ltd.) New York, NY, USA
Bobbs-Merrill (Co., Inc.), Indianapolis, IN, USA
Bonniers (Inc.), New York, NY, USA
A. (Albert) Bonniers Forlag, Stockholm, Sweden
(Thomas) Bouregy (& Co.), New York, NY, USA
(R. R.) Bowker, New Providence, NJ, USA
Boyd & Fraser (Publishing Co.), Boston, MA, USA
(Charles T.) Branford (Co.), Newton Center, MA, USA
(George) Braziller (Inc.), New York, NY, USA
(E. J.) Brill, Leiden, The Netherlands
British Book Centre (Inc.), New York, NY, USA
(F. A.) Brockhaus, Wiesbaden, Germany
Brookings Institution, Washington, DC, USA
Brooks/Cole (Publishing Co.), Pacific Grove, CA, USA
William C. Brown (Co.), Dubuque, IA, USA
Bruce (Publishing Co.), Milwaukee, WI, USA
Burns (Oates & Washbourne, Ltd.), London, U.K.
Butterworth (& Co., Ltd.), London, U.K.
C
Cambridge Univ. Press, Cambridge, U.K.
(Jonathon) Cape (Ltd.), London, U.K.
Carnegie Endowment (for International Peace), New York, NY, USA
Carnegie Foundation (for the Advancement of Teaching), New York, NY, USA
Carnegie Press, Pittsburgh, PA, USA
Cassell (& Co., Ltd.), London, U.K.
Catholic Univ. of America Press, Washington, DC, USA
Caxton (Printers, Ltd.), Caldwell, ID, USA

Century House, Watkins Glen, NY, USA
(W. & R.) Chambers (Ltd.), Edinburgh, U.K.
Chandler (Publishing Co.), San Francisco, CA, USA
Channel Press, New York, NY, USA
Chapman & Grimes (Inc.), Boston, MA, USA
Chapman & Hall (Ltd.), London, U.K.
Chatto & Windus (Ltd.), London, U.K.
Chelsea (Publishing Co.), New York, NY, USA
Chemical Publishing (Co.), New York, NY, USA
Chilton (Co.), Philadelphia, PA, USA
Christian Science Publishing (Society), Boston, MA, USA
Citadel (Press), New York, NY, USA
A. H. Clark (Co.), Glendale, CA, USA
Clarendon (Press), Oxford, U.K.
Clark Univ. Press, Worcester, MA, USA
Collegiate (Press), Ames, IA, USA
(P. F.) Collier (& Son Corp.), New York, NY, USA
Collier-Macmillian (Ltd.), London, U.K.
Columbia Univ. Press, New York, NY, USA
Combat (Forces Press), Washington, DC, USA
Computer Science (Press), Rockville, MD, USA
Comstock (Publishing Associates), Ithaca, NY, USA
Concordia (Publishing House), St. Louis, MO, USA
Concrete (Publications, Ltd.), London, U.K.
Cornell Univ. Press, Ithaca, NY, USA
Coward-McCann (Inc.), New York, NY, USA
CRC Press (Inc.), Boca Raton, FL, USA; (also Cleveland, OH, USA)
Criterion (Press, Inc.), Torrance, CA, USA
(Thomas Y.) Crowell (Co.), New York, NY, USA
Crower-Collier-Macmillian (Inc.), New York, NY, USA
Crown (Publishers, Inc.), New York, NY, USA
D
(Peter) Davies (Ltd.), London, U.K.
(F. A.) Davis (Co.), Philadelphia, PA, USA
John Day (Co., Inc.), New York, NY, USA
(John) De Graff (Inc.), Tuckahoe, NY, USA
Delmar (Publishers, Inc.), Albany, NY, USA

(T. S.) Denison (& Co., Inc.), Minneapolis, MN, USA
(J. M.) Dent (& Sons, Ltd.), London, U.K.
Devin-Adair (Co.), New York, NY, USA
Dial (Press, Inc.), New York, NY, USA
Digital (Press, Inc.), Bedford, MA, USA
Dodd, Mead (& Co., Inc.), New York, NY, USA
Doubleday (& Co., Inc.), New York, NY, USA
Dover (Publications, Inc.), New York, NY, USA
Dow Jones-Irwin (Inc.), Homewood, IL, USA
(Frederick J.) Drake (& Co., Inc.), Chicago, IL, USA
Dryad (Press), Leicester, U.K.
(Gerald) Duckworth (& Co., Ltd.), London, U.K.
Duke Univ. Press, Durham, NC, USA
Duncker & Humblet, Berlin, Germany
Dunod, Paris, France
P. Dupont, Paris, France
(E. P.) Dutton (& Co., Inc.), New York, NY, USA
E
Edinburgh House (Press), London, U.K.
Educational Technology (Publications), Englewood Cliffs, NJ, USA
(J. W.) Edwards (Publisher, Inc.), Ann Arbor, MI, USA
Eldon (Press, Ltd.), London, U.K.
Elsevier (Science Publishing Co.), Amsterdam, The Netherlands; New York, NY, USA
Emerson (Books, Inc.), New York, NY, USA
Encyclopedia Britannica (Inc.), Chicago, IL, USA
Engineering Pub. (Inc.), Elizabeth, NJ, USA
(W.) Englemann, Leipzig, Germany
F
Fairchild (Publications, Inc.), New York, NY, USA
Farrar, Straus (& Giroux, Inc.), New York, NY, USA
(F. W.) Faxon (Inc.), Boston, MA, USA
(Carl) Fischer (Inc.), New York, NY, USA
Fleet (Publishing Corp.), New York, NY, USA
Follett (Publishing Co.), Chicago, IL, USA
Foundation (Press, Inc.), New York, NY, USA
Franey (& Co., Inc.), London, U.K.
(W.H.) Freeman (and Co.), San Francisco, CA, USA

Free Press, New York, NY, USA
(Samuel) French (Inc.), New York, NY, USA
Friedlander & Sohn, Berlin, Germany
Friendship Press, New York, NY, USA
Funk & Wagnalls (Co.), New York, NY, USA
Futura (Publishing Co., Inc.), Mt. Kisco, NY, USA
G
(W. J.) Gage (Ltd.), London, U.K.
Gale & Polden (Ltd.), London, U.K.
Garden City Books, New York, NY, USA
Garland (Publishing, Inc.), New York, NY, USA
Garrett (& Massie, Inc.), Richmond, VA, USA
Gautheir-Villars, Paris, France
(Bernard) Geis (Associates), New York, NY, USA
George Mason Univ. Press, Fairfax, VA, USA
Globe Book (Co., Inc.), New York, NY, USA
Golden Cockerel (Press, Inc.), London, U.K.
Golden (Press, Inc.), New York, NY, USA
(Victor) Gollancz (Ltd.), London, U.K.
Goodheart-Willcox (Co.), Homewood, IL, USA
Gordon & Breach (Publishers, Inc.), New York, NY, USA
Gower (Medical Pub.), New York, NY, USA
GPO (Government Printing Office), Washington, DC, USA
Greenberg (Publishers, Inc.), New York, NY, USA
Greystone (Press), New York, NY, USA
(Charles) Griffin (& Co., Inc.), London, U.K.
Grolier Club, New York, NY, USA
Grolier (Inc.), New York, NY, USA
Grosset & Dunlap (Inc.), New York, NY, USA
Grove (Press), New York, NY, USA
Grune & Stratton (Inc.), New York, NY, USA
Gulf (Publishing Co.), Houston, TX, USA
Gurney (& Jackson), London, U.K.
H
Hafner (Publishing Co.), New York, NY, USA
E. M. Hale (& Co.), Eau Claire, WI, USA
Halsted (Press), New York, NY, USA

Hammond (Inc.), Maplewood, NJ, USA
Harcourt Brace Jovanovich, Orlando, FL, USA
(A.) Harleben, Vienna, Austria
Harper & Row, New York, NY, USA
Harper Collins, New York, NY, USA
W. E. Harrison (& Sons), Ipswich, U.K.
Harrison (& Sons, Ltd.), London, U.K.
Harvard Univ. Press, Cambridge, MA, USA
Hastings (House, Publishers), New York, NY, USA
Hawthorn (Books, Inc.), New York, NY, USA
Hayden (Book Co.), New York, NY, USA
(D. C.) Heath (and Co.), Boston, MA, USA
Heath, Cranton (Ltd.), London, U.K.
(W.) Heffer (& Sons, Ltd.), Cambridge, U.K.
(William) Heinemann (Ltd.), London, U.K.
Helicon (Press, Inc.), Baltimore, MD, USA
Hemisphere (Publishing Corp.), Bristol, PA, USA
(B.) Herder (Book Co.), St. Louis, MO, USA
Heritage (Press), New York, NY, USA
Hermann & Cie, Paris, France
Hermitage (House, Inc.), New York, NY, USA
Hill & Wang (Inc.), New York, NY, USA
Hindawi, Cairo, Egypt; New York, NY, USA
H. M. Stationary Office, London, U.K.
Hodder (& Stroughton, Ltd.), London, U.K.
(Paul B.) Hoeber, New York, NY, USA
Hogarth (Press, Ltd.), London, U.K.
Holiday (House, Inc.), New York, NY, USA
Holt, Rinehart and Winston (Inc.), New York, NY, USA
Horizon (Press, Inc.), New York, NY, USA
Houghton Mifflin (Co.), Boston, MA, USA
Humanities Press (Inc.), New York, NY, USA
(Bruce) Humphries (Inc.), New York, NY, USA
Hutchinson (& Co., Publisher, Ltd.), London, U.K.
Hyperion (Press, Inc.), New York, NY, USA
I
IEEE Comput. Soc. Press, Los Alamitos, CA, USA

IEEE Press, Piscataway, NJ, USA
Indiana Univ. Press, Bloomington, IN, USA
Industrial Press, New York, NY, USA
Industrial (Publications, Inc.), Chicago, IL, USA
Inst. for Advanced Studies, Princeton, NJ, USA
Instrum. Soc. Amer., Research Triangle Park, NC, USA
International Labor Office, Washington, DC, USA
International Publishers (Co., Inc.), New York, NY, USA
International Textbook (Co.), Scranton, PA, USA
International Universities (Press, Inc.), New York, NY, USA
Interscience (Publishers), New York, NY, USA
IOS Press, Amsterdam, The Netherlands
Iowa State Univ. Press, Ames, IA, USA
Iroquois (Publishing Co., Inc.), Columbus, OH, USA
(Richard D.) Irwin (Inc.), Homewood, IL, USA
J
JAI Press, Greenwich, CT, USA
Jarrolds (Publishers, Ltd.), London, U.K.
The Johns Hopkins Univ. Press, Baltimore, MD, USA
Jones & Bartlett, Boston, MA, USA
Jossey-Bass (Inc.), San Francisco, CA, USA
Julian (Press, Inc.), New York, NY, USA
Juta (& Co., Ltd.), Cape Town, South Africa
K
(Willibald) Keller, Leipzig, Germany
(P. J.) Kenedy (& Sons), New York, NY, USA
King's Crown (Press), New York, NY, USA
Kluwer (Academic), Norwell, MA, USA (also, Boston, MA, USA)
Kluwer-Nijhoff (Publishing), Norwell, MA, USA
(W.) Knapp Verlag, Dusseldorf, Germany
Knickerbocker Press, New York, NY, USA
Knight (Publishers, Inc.), New York, NY, USA
(Alfred A.) Knopf, New York, NY, USA
Krieger (Publishing Co.), Melbourne, FL, USA
(Alfred) Kroener, Stuttgart, Germany
(Edward) Kummer, Leipzig, Germany
L

Laidlaw (Brothers, Inc.), River Forest, IL, USA
Longman (Publishing Group), White Plains, NY, USA
M
Macmillan (Inc.), New York, NY, USA
Marcel Dekker (Inc.), New York, NY, USA
Materials Research Soc., Pittsburgh, PA, USA
Matrix, Beaverton, OR, USA
McGraw-Hill (Inc.), New York, NY, USA
MIT Press, Cambridge, MA, USA
Morgan & Claypool (Publishers), San Rafael, CA, USA
Morgan Kaufmann (Publishers, Inc.), San Mateo, CA, USA
(The C. V.) Mosby (Co.), St. Louis, MO, USA
Muhlenbert Press, Philadelphia, PA, USA
J. Murray, London, U.K.
Murray Hill Books, New York, NY, USA
Museum of Modern Art, New York, NY, USA
N
National Academy of Sciences–Nat. Res. Council, Washington, DC, USA
National Academy Press, Washington, DC, USA
National Education Association, Washington, DC, USA
National Geographic Society, Washington, DC, USA
National Industrial Conference Board, Inc., New York, NY, USA
Naval Inst. Press, Annapolis, MD, USA
Naylor (Co.), San Antonio, TX, USA
C. C. Nelson (Publishing Co.), Appleton, WI, USA
(Thomas) Nelson (& Sons), Camden, NJ, USA
New American Library of World Literature (Inc.), New York, NY, USA
New Directions, New York, NY, USA
New York Graphic (Society), Greenwich, CT, USA
New York Univ. Press, New York, NY, USA
Noble (& Noble, Publishers, Inc.), New York, NY, USA
Nonesuch (Library, Ltd.), London, U.K.
Noonday (Press), New York, NY, USA
(P.) Noordhoff (N. V.), Gronigen, The Netherlands
North Holland, Amsterdam, The Netherlands
(W. W.) Norton (& Co.), New York, NY, USA
Nova (Science Publishers), Commack, NY, USA

Now (Publishers), Boston, MA, USA
Noyes (Publications), Park Ridge, NJ, USA
O
(Ivan) Obolensky (Inc.), New York, NY, USA
Oceana (Publications, Inc.), Dobbs Ferry, NY, USA
Odyssey (Press, Inc.), New York, NY, USA
Ohio State Univ. Press, Columbus, OH, USA
R. Oldenbourg-Verlag, Munich, Germany
Oliver & Boyd (Ltd.), Edinburgh, U.K.; London, U.K.
Open Court (Publishing Co.), La Salle, IL, USA
Orange Judd (Publishing Co., Inc.), New York, NY, USA
Orell Fussli-Verlag, Zurich, Switzerland
Orion (Press, Inc.), New York, NY, USA
Oxford, New York, NY, USA
Oxford Book (Co., Inc.), New York, NY, USA
Oxford Science (Publications), Oxford, U.K.
Oxford Univ. Press, London, U.K. (also, New York, NY, USA)
P
(L. C.) Page (& Co.), Boston, MA, USA
Pageant Books (Inc.), New York, NY, USA
Pantheon Books (Inc.), New York, NY, USA
Parents' Inst. (Inc.), Baltimore, MD, USA
Parthenon (Publ. Group), Park Ridge, NJ, USA
Paul Parey Verlag, Berlin, Germany
Pellegrini & Cudahy, New York, NY, USA
Penguin (Books), Baltimore, MD, USA
Peninsula (Publishing), Los Altos, CA, USA
(The William) Penn (Publishing Corp.), New York, NY, USA
Penn. State Univ. Press, University Park, PA, USA
Pentech, Mountain View, CA, USA
Penton (Publishing Co.), Cleveland, OH, USA
(Peter) Peregrinus, Stevenage, U.K.
Pergamon (Press, Inc.), New York, NY, USA
Phaidon (Press, Ltd.), London, U.K.
Pharos Editions, London, U.K.
(George) Philip (& Sons, Ltd.), London, U.K.
Philosophical Library (Inc.), New York, NY, USA

Pitman (Publishing Corp.), New York, NY, USA
Sir Isaac Pitman (& Sons, Ltd.), London, U.K.
Platt & Monk (Co., Inc.), New York, NY, USA
Plays (Inc.), Boston, MA, USA
Pleiad Press, New York, NY, USA
Plenum (Press, Inc.), New York, NY, USA
Popular Mechanics (Press), New York, NY, USA
(Frederick A.) Praeger (Inc.), New York, NY, USA
Prentice-Hall (Inc.), Englewood Cliffs, NJ, USA (also, Upper Saddle River, NJ, USA)
Princeton Univ. Press, Princeton, NJ, USA
Public Affairs Press, Washington, DC, USA
Public School (Publishing Co.), Bloomington, IL, USA
(G. P.) Putnam ('s Sons), New York, NY, USA
Putnam (& Co., Ltd.), London, U.K.
PWS-Kent (Publishing Co.), Boston, MA, USA
Q
Quality (Press), Milwaukee, WI, USA
Quandt, Leipzig, Germany
Quelle und Meyer, G.m.b.H., Heidelberg, Germany
R
Rand McNally (& Co.), Skokie, IL, USA
Random House (Inc.), New York, NY, USA
Raven (Press), New York, NY, USA
(Henry) Regnery (Co.), Chicago, IL, USA
(D.) Reidel, Amsterdam, The Netherlands
(The Peter) P. Reilly (Co.), Philadelphia, PA, USA
Reilly & Lee (Co.), Chicago, IL, USA
Reinhold (Publishing Corp.), New York, NY, USA
Research & Education (Assoc.), Piscataway, NJ, USA
(Fleming H.) Revell (Co.), Westwood, NJ, USA
Reynal (& Co.), New York, NY, USA
Reynal & Hitchcock (Inc.), New York, NY, USA
Rice Univ. Press, Houston, TX, USA
Richards Press (Ltd.), London, U.K.
(John Francis) Rider (Publisher, Inc.), New York, NY, USA
Rinehart (& Co.), New York, NY, USA
Ronald (Press Co.), New York, NY, USA

Routledge (Peterson & Co.), Evanston, IL, USA
Roy (Publishers), New York, NY, USA
Russell Sage (Foundation), New York, NY, USA
Rutgers Univ. Press, New Brunswick, NJ, USA
Ryerson Press, Toronto, ON, Canada
S
SAE (Soc. Automotive Eng.), Warrendale, PA
Sage, Newbury Park, CA, USA
St. Martin's (Press, Inc.), New York, NY, USA
(Howard W.) Sams (& Co.), Indianapolis, IN, USA
(Benjamin H.) Sanborn (& Co.), Chicago, IL, USA
San Francisco Press, San Francisco, CA, USA
(W. B.) Saunders (Co.), Philadelphia, PA, USA
Scarecrow (Press, Inc.), New York, NY, USA
(G.) Schirmer (Inc.), New York, NY, USA
(Henry) Schuman (Inc., Publishers), New York, NY, USA
Science Research (Associates, Inc.), Chicago, IL, USA
Scientific (Press, Inc.), San Francisco, CA, USA
Scientific Book (Corp.), New York, NY, USA
SciTech, Rijeka, Croatia
W. R. Scott (Inc.), New York, NY, USA
Scott, Foresman (& Co.), Glenview, IL, USA
Scott (Publications, Inc.), New York, NY, USA
(Charles) Scribner, New York, NY, USA
Seabury (Press, Inc.), New York, NY, USA
(Martin) Secker & Warburg (Ltd.), London, U.K.
Sergel & Hempel, Brunswick, Germany
A. W. Shaw (Co.), Chicago, IL, USA
Shaker, Aachen, Germany
Sheed & Ward (Ltd.), London, U.K.
Sheed & Ward (Inc.), New York, NY, USA
Shenandoah (Publishing House, Inc.), Strasburg, VA, USA
Sheridan (House, Inc.), Dobbs Ferry, NY, USA
Shoe Lane (Publishing Co.), London, U.K.
Shoe String Press (Inc.), Hamden, CT, USA
SIAM (Soc. Ind. Appl. Math.), Philadelphia, PA, USA
Sidgewick & Jackson (Ltd.), London, U.K.

Silver Burdett (Co.), Morristown, NJ, USA
Simmons-Boardman (Publishing Corp.), New York, NY, USA
Simon and Schuster (Inc.), New York, NY, USA
(L. W.) Singer (Co., Inc.), Syracuse, NY, USA
(Thomas) Skinner (of Canada, Ltd.), Montreal, PQ, Canada
(Thomas) Skinner (& Co.), New York, NY, USA
Skira (International Corp.), New York, NY, USA
(William) Sloane (Associates), New York, NY, USA
SME (Soc. Manufact. Eng.), Dearborn, MI, USA
Richard R. Smith (Co. Inc.), Peterborough, NH, USA
Social Sci. Res. Council, New York, NY, USA
Soncino (Press, Ltd.), London, U.K.
Southern Methodist Univ. Press, Dallas, TX, USA
South-Western (Publishing Co.), Cincinnati, OH, USA
Spartan (Books), Washington, DC, USA
SPIE (Int. Soc. Opt. Eng.), Bellingham, WA, USA
Springer-Verlag, New York; Berlin, Germany; Vienna, Austria
Stackpole (Co.), Harrisburg, PA, USA
Standard & Poor's (Corp.), New York, NY, USA
Standard (Publishing Co.), Cincinnati, OH, USA
Stanford Univ. Press, Stanford, CA, USA
Staples (Press, Ltd.), London, U.K.
Stechert-Hafner (Inc.), New York, NY, USA
Steck-Vaughn (Co.), Austin, TX, USA
Sterling (Publishing Co., Inc.), New York, NY, USA
Stockton (Press), New York, NY, USA
(Frederick A.) Stokes (Co.), Philadelphia, PA, USA
Studio (Publications, Inc.), New York, NY, USA
Alan Swallow, Denver, CO, USA
T
TAB (Books), New York, NY, USA
Talbot (Press, Ltd.), Dublin, Ireland
Taplinger (Publishing Co., Inc.), New York, NY, USA
Taylor & Francis, New York, NY, USA
Technical Press (Ltd.), Surrey, U.K.
Textbooks (Ltd.), London, U.K.
(W.) Thacker (& Co.), London, U.K.

Charles C. Thomas (Publishers), Springfield, IL, USA
Thomas Law Book (Co.), St. Louis, MO, USA
Thomas Publishing (Co.), New York, NY, USA
Time-Warner (Inc.), New York, NY, USA
Transactions Books, New Brunswick, NJ, USA
Transatlantic Arts (Inc.), New York, NY, USA
Triangle Books, New York, NY, USA
Tudor (Publishing Co.), New York, NY, USA
Tupper & Love (Inc.), Doraville, GA, USA
(Charles E.) Tuttle (Co., Inc.), Rutland, VT, USA
Twayne (Publishers, Inc.), New York, NY, USA
Twentieth Century (Fund, Inc.), New York, NY, USA
U
Underwriter's Lab., Chicago, IL, USA
Frederick Unger (Publishing Co.), New York, NY, USA
Univelt (Inc.), San Diego, CA
Univ. of California Press, Berkeley, CA, USA
Univ. of Chicago Press, Chicago, IL, USA
Univ. of Connecticut Press, Storrs, CT, USA
Univ. of Florida Press, Gainesville, FL, USA
Univ. of Illinois Press, Urbana, IL, USA
Univ. of Iowa Press, Iowa City, IA, USA
Univ. of Kentucky Press, Lexington, KY, USA
Univ. of London Press, (Ltd.), London, U.K.
Univ. of Michigan Press, Ann Arbor, MI, USA
Univ. of Minnesota Press, Minneapolis, MN, USA
Univ. of Missouri Press, Columbia, MO, USA
Univ. of Nebraska Press, Lincoln, NE, USA
Univ. of New Mexico Press, Albuquerque, NM, USA
Univ. of North Carolina Press, Chapel Hill, NC, USA
Univ. of Notre Dame Press, Notre Dame, IN, USA
Univ. of Oklahoma Press, Norman, OK, USA
Univ. of Pennsylvania Press, Philadelphia, PA, USA
University Science (Books), Mill Valley, CA, USA
Univ. of Pittsburgh Press, Pittsburgh, PA, USA
Univ. of Texas Press, Austin, TX, USA
Univ. of Washington Press, Seattle, WA, USA

Univ. of Wisconsin Press, Madison, WI, USA
Univ. of Virginia Press, Charlottesville, VA, USA
(T. Fisher) Unwin, London, U.K.
V
Vanguard (Press, Inc.), New York, NY, USA
(D.) Van Nostrand (and Co., Inc.), New York, NY, USA
VCH (Publishers, Inc.), New York, NY, USA
Viking (Press), New York, NY, USA
W
Wadsworth (Publishing Co.), Belmont, CA, USA
J. F. Wagner (Inc.), New York, NY, USA
(George) Wahr (Publishing Co.), Ann Arbor, MI, USA
(Frederick) Warne (& Co., Inc.), New York, NY, USA
Warwick & York (Inc.), Baltimore, MD, USA
(Ives) Washburn (Inc.), New York, NY, USA
Watson-Guptill (Publications, Inc.), New York, NY, USA
(C. A.) Watts (& Co., Ltd.), London, U.K.
Franklin Watts (Inc.), New York, NY, USA
Wayne State Univ. Press, Detroit, MI, USA
Webb (Publishing Co.), St. Paul, MN, USA
Webster (Publishing Co.), St. Louis, MO, USA
Wellesley-Cambridge (Press), Cambridge, MA, USA
West (Publishing Co.), St. Paul, MN, USA
Westminster (Press), Philadelphia, PA, USA
Westview (Press, Inc.), Boulder, CO, USA
Whiteside (Inc.), New York, NY, USA
A. Whitman (& Co.), Chicago, IL, USA
Whitman (Publishing Co.), Racine, WI, USA
Whittlesey House, New York, NY, USA
W. A. Wilde (Co.), Natick, MA, USA
(John) Wiley (& Sons, Inc.), Hoboken, NJ, USA
Willett, Clark (& Co.), Chicago, IL, USA
Williams & Nargate (Ltd.), London, U.K.
Williams & Wilkins (Co.), Baltimore, MD, USA
H. W. Wilson (Co.), New York, NY, USA
(William H.) Wire (& Co., Inc.), Union City, NJ, USA
Wise (Book Co.), New York, NY, USA

(M.) Witmark (& Sons), New York, NY, USA
(George) Wittenborn (Inc.), New York, NY, USA
(William) Wood (& Co.), Baltimore, MD, USA
World Book (Co.), New York, NY, USA
World (Publishing Co.), Cleveland, OH, USA
World Scientific, Singapore
WSES, Crete, Greece
(A. A.) Wyn (Inc.), New York, NY, USA
Y
Yale Univ. Press, New Haven, CT, USA
Year (Inc.), New York, NY, USA
Year Book Medical (Publishers, Inc.), Chicago, IL, USA
(Thomas) Yoseloff (Inc.), New York, NY, USA
Z
Ziff-Davis (Publishing Co.), Chicago, IL, USA

C. Abbreviations of Periodicals With Non-English Titles

A
Acad. Serbe Sci. Arts Glas Cl. Sci. Tech.
Acta Acust.
Acta Astron. (Poland)
Acta Astron. Sin. (China)
Acta Astronaut. (U.K.)
Acta Astrophys. Sin. (China)
Acta Autom. Sin.
Acta Cienc. Indica Math.
Acta Cienc. Indica Phys.
Acta Crystallogr. A, Found. Crystallogr.
Acta Crystallogr. B, Struct. Sci.
Acta Crystallogr. C, Cryst. Struct. Commun.
Acta Electron. (France)
Acta Cyberno
Acta Electron. Sin. (China)
Acta Geod. Geophys. Montan. Hung.
Acta Geophys. Pol.
Acta Geophys. Sin. (China)
Acta Geophys. Sin. (USA)
Acta Metall.
Acta Mex. Cienc. Tecnol.
Acta Phys. Hung.
Acta Phys. Pol. A
Acta Phys. Pol. B
Acta Phys. Sin.
Acta Phys. Slovaca
Acta Politec. Mex.
Acta Polytech. Scand. Appl. Phys. Ser.
Acta Polytech. Scand. Chem. Technol.
Metall. Ser.
Acta Polytech. Scand. Electr. Eng. Ser.
Acta Polytech. Scand. Math. Comput. Sci. Ser.
Acta Polytech. Scand. Mech. Eng. Ser.
Acta Seismol. Sin.
Acta Tech. Acad. Sci. Hung.
Acta Tech. CSAV
Acustica
(AEU) Arch. Elektr. Ubertragung
Akust. Zh.
Algorithmica
Alta Freq.
An. Acad. Bras. Cienc.
An. Fis.
An. Mec. Electr.
Angew. Inform.
Ann. Inst. Henri Poincare Phys. Theor.
Ann. Soc. Sci. Brux. I, Sci. Math. Astron. Phys.
Arch. Elektr. Uebertrag. (AEU) (before 1971)
Arch. Elektron. Uebertrag. Tech. (after 1971)

Arch. Elektrotech. (Poland)
Arch. Elektrotech. (Germany)
Ark. Fys. Semin. Trondheim
Astrofizika
Astron. Nachr. (Germany)
Astron. Tidsskr.
Astron. Vestn.
Astron. Zh.
Atomwirtsch.-Atomtech.
Atti Accad. Sci. Ist. Bologna CI. Sci. Fis. Rend. XIII
Atti Accad. Sci. Torino I, CI. Sci. Fis. Math. Nat.
Autom. Strum.
Autom. Tech. Prax.
Automatica
Automatie
Automatika
Automatisierungstechnik
Automatizace
Automedica
Avtom. Telemekh.
Avtom. Vychisl. Tekh.
Avtomatika
Avtometriya

B

Ber. Bunsenges. Phys. Chem.
Biofizika
Biometrika
Boll. Geofis. Teor. Appl.
Bull. Acad. Serbe Sci. Arts cl. Sci. Tech.
Bull. Annu. Soc. Suisse Chronom. Lab. Suisse. Rech. Horlog.
Bull. Cl. Sci. Acad. R. Belg.
Bull. Dir. Etud. Rech. A
Bull. Dir. Etud. Rech. B
Bull. Dir. Etud. Rech. C
Bull. Liaison Rech. Inform. Autom.
Bur. Etud. Autom.

C

CFI-Ceram. Forum Int.-Ber. Dtsch. Keram. Ges.
Chem. Scr.
Ciel Terre
Cybernetica

D

Deut. Hydrogr. Z.
Dokl. Akad. Nauk SSSR

E

Electroacoustique
Electrochim. Acta
Electrochim. Metal.
Elektor Electron.
Elektr. Bahnen
Elektr. Energ.-Tech.
Elektr. Masch.
Elektr. Stn.
Elektrichestvo
Elektrie
Elektrizitaetswirtschaft
Elektro
Elektro-Anz.
Elektro-Jahr
Elektrokhimiya
Elektron
Elektron Int.
Elektron. Entwitkl.
Elektron. Ind
Elektron. J.
Elektron. Prax.
Elektron. Tekh.
Elektronica
Elektronik
Elektronika
Elektroniker
Elektronikschau
Elektrosvyaz
Elektrotech. Cas.
Elektrotech. Inf. Tech.
Elektrotech. Obz.
Elektrotechniek
Elektrotechnik (Czechoslovakia)
Elektrotechnik (Switzerland)
Elektrotechnik (Germany)
Elektrotechnika
Elektrotehnika, Zagreb
Elektrotekhnika
Elektroteknikeren
Elektrowaerme Int. B.
Elettrificazione
Elettron. Oggi
Elettron. Telecomun.
Elettrotecnica
Elek. Med Aktuell Elektron.
Elteknik
Energ. Atomtech.
Energ. Elettr.
Energetica
Energetik
Energetika
Energetyka
Energia Nuclear
Energie Technik (Germany)
Energie Technik (Switzerland)
Entropie
ETZ
ETZ Arch.

F

Feingeraetetechnik
Feinw. Tech. Messtech.

Fert. Tech. Betr.
Fis. Tecnol.
Fiz. Khim. Obrab. Mater.
Fiz. Met. Metalloved
Fiz. Nizk. Temp.
Fiz. Plazmy
Fiz. Tekh. Poluprovodn.
Fiz. Tverd. Tela
Fiz.-Khim. Mekh. Mater.
Fizika
Forsch.-Ber. Landes Nordrh.-Westfal.
Frequenz
Fys. Tidsskr.
G
G. Fis.
Geliotekhnika
Geochim. Cosmochim. Acta
H
Haerterei-Tech. Mitt.
Helv. Chim. Acta
Helv. Med. Acta
Helv. Phys. Acta
Hochfreq. Electroakust
Hoppe-Seylers Z. Physiol. Chem.
I
Inf. Elektron.
Inf. Elettron.
Inform. Forsch. Entwickl.
Inform. Spektrum
Inform.-Fachber.
Informatie
Informatik
Informatologia Yugosl.
Informatyka
Infowelt
Ing. Electr. Mec.
Ing. Mec. Electr.
Ing.-Arch.
Inzh.-Fiz. Zh.
Izmer. Tekh.
Izv. Akad. Nauk Arm. SSR Ser. Tekh. Nauk
Izv. Akad. Nauk SSSR Energ. Transp.
Izv. Akad. Nauk SSSR Fiz. Atmos. Okeana
Izv. Akad. Nauk SSSR Fiz. Zemli
Izv. Akad. Nauk SSSR Ser. Fiz.
Izv. Vyssh. Uchebn. Zaved. Elektromekh.
Izv. Vyssh. Uchebn. Zaved. Radioelektron.
Izv. Vyssh. Uchebn. Zaved. Radiofiz.
J
J. Chim Phys. Phys.-Chim Biol.
K
Kernenergie
Kerntechnik
Khim. Fiz.
Kibern. Vychisl. Tekh.
Kibernetika
Kristallografiya
Kvantovaya Elektron. Mosk.
Kybernetes
Kybernetika
M
Med. Tek.
Mekh. Avtom. Proizvod.
Meres Autom.
Mesures
Metallofizika
Metalloved. Term. Obrab. Met.
Meteorol. Gidrol.
Meteorol. Rundsch.
Metrol. Apl.
Metrologia
Medel. Simul.
N
Nachr. Dok.
Nachr.tech. Elektron.
Naturwissentchaften
Neue Tech.
Neue Tech. Buero
Nukleonika
Numer. Math.
Nuovo Cimento A
Nuovo Cimento B
Nouvo Cimento C
Nuovo Cimento D
O
Okeanologiya
Opt. Spektrosk.
Opt.-Mekh. Prom.
Optik
P
Photogrammetria
Photonics Spectra
Pis'ma Astron. Zh.
Pis'ma Zh. Eksp. Teor. Fiz.
Pis'ma Zh. Tekh. Fiz.
Poverkhn., Fiz. Khim. Mekh.
Pr. Inst. Elektrotech.
Prib. Sist. Upr.
Prib. Tekh. Eksp.
Prikl. Mat. Mekh.
Prikl. Mekh.
Probl. Kibern.
Probl. Peredachi Inf.
Proc. K. Ned. Akad. Wet. B, Palaeontol.
Anthropol.
Programmirovanie
Prz. Elektrotech.

Prz. Telekomun.
PT/Elektrotech. Elektron.
R
Radio Fernsehen Elektron.
Radiotekh. Elektron.
Radiotekhnika Mosk.
Rev. Acad. Cienc. Zaragoza
Rev. Electrotec. (Argentina)
Rev. Electrotec. (Spain)
Rev. Energ.
Rev. Esp. Electron. Rev. Geofis.
Ric. Autom.
Ric. Spettrosc.
Robotersysteme
Rozpr. Electrotech.
S
Sadhana
Schweiz. Tech. Z.
Scientia
Siemens Forsch. Entwickl. Ber.
Sist. Autom.
Sitzungsber. Oester. Akad. Wiss. Math.-Naturwiss. Kl. Abt. II (Austria)
Spectrochim. Acta A, Mol. Spectrosc.
Spectrochim. Acta B, At. Spectrosc.
Sprache Datenverarb.
Stanki Instrum.
Steklo Keram.
Svetotekhnika
T
TE Int.
Tech. Bull. Vevey
Tech. Mitt. Krupp (Engl. Ed.)
Tech. Mitt. PTT
Tech. Mitt. RFZ
Technica
Tecnica
Teh. Fiz.
Tehnika
Tekh. Elektrodin.
Tekh. Kibern.
Tekh. Kino Telev.
Tekh. Misul
Telekomunikacije
Telektronikk
Teleteknik
Teor. Mat. Fiz.
Teploeoergetika
Teplofiz. Vvs. Temp.
Tidskr. Dok.
TN Nachr.
Toute Electron.
Tr. Inst. Teor. Astron.
U
Ukr. Fiz. Zh.
Usp. Fiz. Nauk
V
Vak.-Tech.
VDE Fachiber.
VDI Z.
Vestn. Mashinostr.
Vestn. Mosk. Univ. 15, Vychisl. Mat. Kibern.
Vestn. Mosk. Univ. 3, Fiz. Astron.
Vesti Akad. Navuk BSSR Ser. Fiz. Energ. Navuk
VGB Kraftwerkstech. (Ger. Ed.)
Vide Couches Minces
Vistas Astron.
Vopr. At. Nauki Tekh. Ser., Fiz. Radiats. Povrezhdenii Radiats. Materialoved.
Vopr. At. Nauki Tekh. Ser., Obshch. Yad. Fiz.
Vuoto Sci. Tecnol.
W
Wiss. Z. Friedrich-Schiller-Univ. Jena Nat.wiss. Reihe
Wiss. Z. Karl-Marx-Univ. Leipz. Math.-Nat.wiss. Reihe
Wiss. Z. Tech. Hochsch. Ilmenau
Wiss. Z. Tech. Univ. Dresd.
Wiss. Z. Tech. Univ. Karl-Marx-Stadt
Y
Yad. Fiz.
Z
Z. Angew. Math. Mech.
Z. Angew. Math. Phys.
Z. Met.kd.
Z. Nat. Forsch. A, Phys. Phys. Chem. Kosmophys.
Z. Oper. Res. A, Theor.
Z. Oper. Res. B, Prax.
Z. Phys.
Z. Phys. A, At. Nuclei
Z. Phys. B, Condens. Matter
Z. Phys. C, Part Fields
Z. Phys. Chem. Neue Folge
Z. Phys. Chem., Leipz.
Z. Phys. D, At. Mol. Clusters
Zavod. Lab.
Zh. Eksp. Teor. Fiz.
Zh. Fiz. Khim.
Zh. Prikl. Mekh. Tekh. Fiz.
Zh. Prikl. Spektrosk.
Zh. Tekh. Fiz.
Zh. Vychisl. Mat. Mat. Fiz.
Zisin, J. Seismol. Soc. Jpn.

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Lesson 6 Glossary: Listening and Speaking

Vocabulary

360 review (noun): an employee review process that solicits input from an employee's colleagues, direct reports, managers, project leaders, and others. The "360" is a reference to the idea of a full circle.

ad hoc (adjective): as needed.

allocated (adjective): designated, as used in the passage herein.

benchmarks (noun, plural): a standard point of reference; a stated goal.

diversification (noun): the process of establishing a variety of skills or options within an organization.
enterprise-wide (adjective):

expenditures (noun, plural): costs.

exponentially (adverb): multiplied by several factors; of much greater magnitude.

f2f (jargon): translates to the phrase "face to face," whereas the "2" replaces the word "to."

fiscal year (noun): a year (12 months) for accounting and taxation purposes. A fiscal year may or may not be synced to the calendar year.

Gantt chart (noun): a chart that helps teams or individuals to track workflow, deadlines, and benchmarks. Horizontal lines span columns (usually in a spreadsheet or similar) to denote a period of time where a task is in action.

in-house (adjective): from the company, within the company, or for the company.

logjam (noun): an intractable problem; one that seemingly that cannot be solved; also, a system which is unable to move.

metrics (noun): tools or systems for measuring performance or change.

predicated (verb): based on, created on the basis of.

roadblock (noun): obstacle, hindrance.

notwithstanding (adverb): despite, in spite of.

procured (verb): to obtain with some effort or precision.

seamless (adjective): without any visible dividing lines; without any problems or obstacles.

soliciting (verb): gathering or collecting, as used in this document. Note: This word has other meanings outside of the one used in this course.

specs (noun, plural): shortened form of "specifications."

stabilized (verb, past tense): solid, predictable.

streamline (verb): to make more efficient.

synchronous (adjective): existing or working at the same time.

versioned (verb): as it is used in the Lesson 6 passage, this word is functioning as a verb, "to version." This is a business-like jargon use of the word, which is usually a noun.

workflow (noun): a sequence of work-related tasks, jobs, or processes.

Idioms or Phrases

(to) be in the loop: to be included in communications; to be current.

client-facing deliverables: items that are created for the client.

flip side: the other side; another aspect.

(to) get on board with: to agree with; to be in accord with.

head on: directly; face to face.

(to) keep straight: to keep everything organized; to understand confusing details.

post-mortem review: a review of a project after it has finished.

(to) put (someone's) cards on the table: to be honest and straightforward.

(to) ramp up: to speed up, increase, or put more energy into something.

track record: a history of performance

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Lesson 6 Transcript

Speaker: Myra

Good morning, Logrify team! I'm here for a few brief minutes today to announce a new initiative that promises to make your life simpler, clearer, more efficient--and, frankly, more enjoyable. I've been here at Logrify for 12 years. If you're like me, during the past several fiscal cycles, you've seen the company grow exponentially through product diversification and expansion into previously unexplored markets. That's the good news. But there is a flip side to that positive outcome. And that is, we're running into logjams and roadblocks of greater and greater scale. Some of these problems occur on a weekly or even daily basis. They're the kind of internal issue that causes not only personal frustration, but also real economic impact. We're going to all need to address those issues head on. Let me describe briefly what the problems are, and how they affect all of us.

Now, as you know, every Logrify department has developed its own system for tracking projects--whether by depositing documents in the cloud, using Google Drive, relying on specific individuals to provide summaries and task updates, or just keeping paper-and-pencil running tabs. These systems worked for their purposes in the past. Nevertheless, their success was predicated on a few individuals having ready access to each other, for easy communication. Notwithstanding those good track records, small-scale tracking systems just don't work as well when a division of five grows to 120, or when three key people on a project are geographically distant from each other. A recent study by I-D-C showed that larger organizations, like the Logrify we have today, lose up to 30% of their work day in inefficiencies when there is no standardized project management system. I think you'll agree that the 2 ½ hours a day lost while searching for in-house documents, which the study cites, is unacceptable.

What we need is clear. With a single, integrated system, you will be able to track completions of tasks within minutes, immediately determine responsible actors for those tasks, measure economic impacts, and get the data you need in real time, instead of waiting for days until someone hundreds of miles away gets back to you. Imagine getting what you need in three mouse clicks. Would that be an improvement over what you have now?

But let's be realistic. Let's ask ourselves: what should we expect from a project management system, anyway? The answer lies in you: what are your needs and wants? Where have you seen inefficiencies, and where have you been unable to get the information you need? Some departments have complained that they don't always know the status of the work or can't easily share information with all the stakeholders on a project. Others seem to consistently have challenges keeping to a schedule. We suspect at least part of the problem comes from the lack of a centralized project management system. And we're looking to meet everyone's needs for a successful, dependable workflow.

We can reach that common goal this year. Within Logrify, we will be working hard to identify an appropriate management system within the next six weeks. Within the next two weeks you'll receive in your Logrify email a survey link asking you to report on your specific wants and needs. Many of you listening to this message will also have a face to face interview with a project team member. We will factor the data into a statement of needs that will drive our purchase of a new project management system. Please look for the survey in your inbox. With your full participation, we can make a more seamless, successful, profitable and effective

workplace that we can all be proud of. Thank you for your full attention. If you have any questions my contact information follows. By working together, we'll help Logrify reach its full potential in this year and beyond.

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Lesson 6 Reading Excerpt #1

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To: Engineering Teams
From: Logrify Enterprise Project Management Office (EPMO)
Myra Patel, lead
Re: Project Management Software, seeking input from engineering teams

Summary
*Logrify's documentation processes must be updated and **stabilized** in order to make our work more accurate, efficient, predictable, searchable, and useful. The **EPMO** (*Enterprise Project Management Office) *is **soliciting** feedback from in-house technical experts to help identify project management software needs.*

Explanation
When Logrify, Inc. analyzed data from the last **fiscal year** [1], one of the **benchmarks** was a **360 review** of the **workflow** processes that our technical teams use on a daily basis. The goal of that review process was to identify places within Logrify that could potentially deploy time-saving processes, supporting software, or other adjustments to **streamline** work and increase productivity and convenience across working groups.

Once the EPMO had sifted through the data, one key area that was identified for improvement was *project management* for our various product lines, their technical development streams, the research and development that support those teams, and timely delivery of products to clients or suppliers.

To that end, the EPMO will be recommending that Logrify move away from its current **ad hoc** project management practices and purchase an **enterprise-wide** project management software package. As you know, right now, each department has its own internal method of tracking projects, and none of those methods are standardized, nor do those systems talk to each other in any sort of predictable way. For example, if an engineer on the Circuits team (located in India) needed to get specifications on a sensor being used for a particular project, the only way to get that information would be to email the Sensors team (in the US), identify the right person, and then request the **specs** via email. This approach wastes time and energy; as well, if the sensor specialist is away from work, it could be days before the proper information could be **procured**. Some teams have been using our internal network, some have been using Google Drive, some have used cloud services, and some have been using hard copies stored in file cabinets. We need a better system.

Our company is not the only one that struggles with standardizing processes like these. In 2012, the firm IDC collected data from technical firms in the USA, UK, France, Germany, Australia and Japan [2]. They found that employees spent around 2.5 hours a day, on average (which is 30% of the work day), just searching for **in-house** documentation that had been misfiled, never filed, uncategorized, improperly saved, tied up behind unnecessary passwords or protections, or **versioned** improperly. The data from Logrify's own statistics and **post-mortem reviews** confirms the findings of IDC: on average, 2-3 hours a day is lost from each Logrify employee trying to locate project information that should be easy to find. The math makes the point even more clear. Logrify has 500 employees. The average salary is US$80,000/year. That means that Logrify is potentially wasting US$12.5 million a year because employees can't find the information that they need quickly.

A related issue has also come to light after our year-end review. More often than we knew, work efforts across the organization have been duplicated because teams in different departments did not know that other teams were working on the same task. From our calculations, we found that duplication of effort led to Logrify employees losing over 5,000 work hours in the last year alone. With a project management package in place, and with all workers using it diligently, unnecessary duplication of work could become a thing of the past.

We understand that it is difficult to introduce a major change into how we work every day. Nevertheless, we are fully confident that all sectors will embrace the improved flow of information between teams, project leaders, and management. At any rate, the EMPO team is certain that the benefits of purchasing and using a project management system for Logrify work will quickly allow us to see a return on investment. As well, it is our intention to simplify your day and workflow by having a stable and predictable enterprise-wide system that every employee can use.

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Lesson 6 Reading Excerpt #2

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[continued from Reading Excerpt #1]

Next Steps
In the next six weeks, the EMPO team will be gathering a "needs and wants" list for the software from all internal teams and working groups. Once those responses have been gathered, the EMPO team will determine which software package will be the best fit for Logrify's needs.

The first cycle of information gathering will be through an electronic survey. Please watch your Logrify email account; you will receive a survey link, and completing the survey should take less than ten minutes. The second cycle will include **f2f** interviews, as needed, with specific teams.

Initial Needs Assessment
The EPMO has determined that any project management program (PMP) should contain features that support these activities:

- *Plan:* Provide a platform and **Gantt chart** templates for planning and scheduling all dates, benchmarks, and testing cycles
- *Track:* Provide a dashboard view of project status and each sub-task
- *Budget:* Provide updated and synced **expenditures** against **allocated** budget
- *Collaborate:* Provide in-program channels for team meetings via web calls, conference calls, or **synchronous** messaging with attachments
- *Archive*: Provide **seamless**, predictable file processes and actions for all structured files (documents and slides) as well as unstructured files such as CAD files, drawings, circuit drawings, scans, uploaded photos, emails, project-specific text messages, video and voice meeting captures, and the like.
- *Access and Share:* Provide in-system processes for securely sharing files, sending and receiving verified electronic signatures, and the like, for both in-house and **client-facing deliverables**. Access should include being mobile-friendly.
- *Report:* Produce automated weekly, monthly, or yearly statistics for a variety of data inquiries.

Final Steps
Once feedback has been gathered and vetted, the EPMO will determine which project management system will work best for Logrify's specific needs. Our hope is that the entire process of information-gathering and analysis will only take six weeks.

Procurement of a system could be almost instantaneous because it will be purchased online. And while that piece of the puzzle will be easy and fast, the next step will be thorough onboarding and training of all employees, across all sectors, for use of the new system. We expect that all employees will be fully functional in the system by the end of this coming fiscal year.

The very last steps are twofold:

- begin a concerted, ongoing effort to gather what is known on all currently running projects and bring all of those artifacts into the new system
- work backwards, as time allows, and enter all projects and their artifacts from the last two years

Pulling in current and recent projects will allow Logrify to begin collecting statistics and other evidence of gains or losses in workflow efficiencies. It is expected that all teams will participate in these efforts.

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Lesson 6 Speaking: Concession 2 Statements

What you heard:

1. Your department posts Gantt charts. However, I'm not sure they're referenced regularly.

2. The lead engineer is good about keeping the budget updated. At the same time, his summaries are hard to read.

3. His team leader believes in collaboration. Nevertheless, the team rarely meets.

4. Having a good archival system is essential. Regardless, maintaining good communication is even more important.

5. The information in the reports is extremely useful. Still, they tend to be out of date.

How you could have responded:

(1)

- Although your department posts Gantt charts, I'm not sure they're referenced regularly
- Despite your department's posting of Gantt charts, I'm not sure they're referenced regularly.
- In spite of your department's posting of Gantt charts, I'm not sure they're referenced regularly.
- Regardless of your department's posting of Gantt charts, I'm not sure they're referenced regularly.

(2)

- Although the lead engineer is good about keeping the budget updated, his summaries are hard to read.
- Despite your lead engineer's good work in keeping the budget updated, his summaries are hard to read.
- In spite of your lead engineer's keeping the budget updated, his summaries are hard to read.
- Regardless of your lead engineer's keeping the budget updated, his summaries are hard to read.

(3)

- Although the team leader believes in collaboration, the team rarely meets.
- Despite the team leader's belief in collaboration, …
- In spite of the team leader's belief in collaboration, …
- Regardless of the team leader's belief in collaboration, …

(4)

- Although having a good archival system is essential, maintaining good communication is even more important.
- Despite the fact that having a good archival system is essential, …

- In spite of the fact that having a good archival system is essential, …
- Regardless of the fact that having a good archival system is essential, …

(5)

- Although the information in the reports is extremely useful, they tend to be out of date.
- Despite the fact that the information in the reports is extremely useful, …
- In spite of the fact that the information in the reports is extremely useful, …
- Regardless of the fact that the information in the reports is extremely useful..

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Lesson 6 Speaking Transcript:

A Meeting with Roberto, Terry, and Bella

For terms in bold, see Glossary.

Roberto: Hey, everyone. Thanks for coming in earlier than usual on a Friday. In the interest of time, let's go ahead and get started, shall we? Let's begin by talking about the idea of the initiative itself.

Terry: Look: I'm going to put my cards on the table. Frankly, I'm not quite sure about **getting on board** with a new project management system. It seems to me that using the cloud for storage, plus backup from paper copies, has been serving us fine up to this point.

Roberto: I can understand why you feel that way.

Bella: I have to agree. And I have a different concern. Would a new system that's designed with the entire company's needs in mind be more than a small division like ours needs? After all, when was the last time we failed to meet a deadline or missed a task in a project plan?

Roberto: Bella, I think your points are well taken. You, Terry and I make up a division with a good **track record** on project management, with no question. We can take pride in that. At the same time, our situation could change. What would happen if our schedule **ramps up** considerably and each one of us had to take on several projects? Keeping everything straight could be an entirely new proposition.

Bella: I hadn't thought of that, but I see your point.

Roberto: And there's something else to think about. If we're on the road with only a cell at hand, depending on paper copies, and even cloud access, might prove awkward.

Terry: That's happened to me a few times. And actually, I've been on the road a lot more this past month.

Bella: Well, I'm not traveling, so I don't see it the same way. And can we talk about the white paper?

Roberto: Of course. What did you think of it?

Bella: Look, the assumptions in that paper were just not applicable to us. The companies surveyed were in Western Europe, and we're mostly based in North America. I tend to spend at least half my week in research, and those respondents said they only spend 6 ½ hours.

Roberto: Are you saying that small differences in how they use their work week would make the findings completely irrelevant? Do you see any similarities in the white paper between their situation and ours?

Bella: Sure, they depend on documents, like we do. And we do spend a lot of time looking for in-house documentation. But the study seems flawed. Look, their hours spent on different tasks totaled over 47 per week per person and yet they reported working just 44 on average.

Roberto: You've always had a good eye for discrepancies, Bella. Notwithstanding those issues, though--aren't there times when you get frustrated when you can't locate a document quickly? The report indicated five hours spent searching, and three hours spent filing. Let me ask you. If that's at all close to the time you waste on document searches, what would you do if you could have that time back?

Bella: That's a welcome thought. I suppose I'd do more phone interviews with sensor manufacturers about causes for defects and return rates. Right now I only have time for brief sampling by geographic location.

Roberto: That would be extremely useful to our whole team.

Terry: That's data I'd like to have access to, myself.

Roberto: So, can we agree as a group that we'd like to have more wiggle room in our work week for serious research rather than housekeeping chores? Especially some that we can get rid of, or spend less time on?

Bella and Terry: (overlapping voices) Seems logical to me. / Can't argue with that. Sure.

Roberto: Then we have a direction forward. Let's wait for the survey link that they promised to send out. Fill it out based on your own personal experiences and your preferences. Myra has promised to look at all the feedback person by person as well as department by department. She'll give us an update when she's able to start sketching out the big picture. So we'll be **in the loop** all along the way. Does that sound like a plan?

Bella and Terry: (overlapping) Sounds good to me. / So far, so good.

(end)

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Lesson 6 Reading Excerpt #1

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Review

Our company is not the only one that struggles with standardizing processes like these. In 2012, the firm IDC collected data from technical firms in the USA, UK, France, Germany, Australia and Japan [2]. They found that employees spent around 2.5 hours a day, on average (which is 30% of the work day), just searching for in-house documentation that has been misfiled, never filed, uncategorized, improperly saved, tied up behind unnecessary passwords or protections, or versioned improperly. The data from Logrify's own statistics and **post-mortem reviews** confirms the findings of IDC: on average, 2-3 hours a day is lost from each Logrify employee trying to locate project information that should be easy to find.

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Lesson 6 Writing Hints

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Correct	Incorrect
5 V	5V
1.17 V	1.17Volts or 1.17volts or 1.17V
8 ohm or 8 Ω	8ohm or 8Ω
18 cm	18cm
2700 mm	2700mm
19 °K	19°K, 19°Kelvin, 19°k

Correct	Incorrect
This engine must meet Tier 4 standards for CO_2 emissions.	This engine must meet Tier 4 standards for Carbon Dioxide emissions.
This engine must meet Tier 4 standards for carbon dioxide emissions.	