The Challenge in Balancing Data Collection Innovations, Remaining Practical, and Being Cost-Effective

Leonard Hart, Scott Reid, and Erin Slyne, Mathematica Policy Research
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Survey organizations continuously develop innovative and complex data collection designs, which in these increasingly difficult economic times have to be implemented as efficiently and cost-effectively as possible.

This paper describes how we use the built-in capabilities of the Blaise programming suite, both out of the box and integrated with custom-built applications, to meet this challenge. We also explain our plans to expand our use of Blaise in order to keep up with the ever-changing landscape of information technology (IT) and the impact it can have on our future data collection efforts.

1 Background

1.1 Philosophy on Efficiency and Cost-Effectiveness of Data Collection Efforts

Mathematica Policy Research's mission is to "… improve public well-being by bringing the highest standards of quality, objectivity, and excellence to bear on the provision of information collection and analysis to our clients."[1] We are also widely recognized for having experts in the areas of social science research and evaluation on staff; we have received numerous awards and honors for the contributions they have made in providing high quality research using innovative methods.[2]

However, Mathematica is more than just a mission statement and staff looking to provide high quality analytical results. It is also an employee-owned company attempting to maintain and develop long-term effectiveness and growth opportunities. To accomplish these goals, while remaining self-sufficient financially, we have to be as efficient and cost-effective as possible when it comes to our data collection efforts and using Blaise as one of our primary data collection tools.

Before discussing Blaise topics in detail, we will examine current technological trends, the U.S. political and economic landscape, and the concerns that all organizations face in these difficult economic times. Finally, we will illustrate how we use Blaise to handle these data collection challenges while still meeting our goals.

1.1.1 Remaining Competitive and Capable

As we began our research for this paper, we realized Mathematica is not alone in its concern to remain competitive while meeting the research goals of our external and internal clients, especially during difficult economic times.

A number of conference panels and town hall meetings at the Gartner Symposium/ITxpo 2010 focused on the desire of chief information officers (CIOs) to keep their operations running despite

[1] "Our Mission." Mathematica Policy Research corporate website. Available at http://www.mathematica-mpr.com/About_Us/mission.asp. Accessed February 14, 2012.

[2] "Awards and Honors." Mathematica Policy Research corporate website. Available at http://www.mathematica-mpr.com/About_Us/awards.asp. Accessed February 14, 2012.

reduced budgets, while also wrestling with rapidly evolving technology.[1] In his article covering this event for *eweek.com*, Nicholas Kolakowski brought attention to research notes released during the conference by Gartner analysts that broke down several primary concerns of chief executive officers (CEOs) that their CIOs should address.[2] Two concerns caught our attention:

1. **Fading confidence.** The global recession has apparently left many CEOs in a pessimistic frame of mind, causing them to reduce their more optimistic investments in technology and other areas. To address this concern, CIOs should assume their IT resources will either decline or remain static in 2011.
2. **Investing in new cost efficiencies.** CEOs increasingly focus on systemic efficiencies. As a result, CIOs should examine how to contribute to saving costs (that is, they should introduce automation policies).[3]

1.1.2 "Smarter, Faster, Cheaper"

Pessimism over the global economy and the realization that investments in systemic cost-efficiency methods are needed were two of the prime reasons the mantra of "Smarter, Faster, Cheaper" was often quoted in the past half decade. We hear this refrain recited in all business sectors, not only in areas of public policy research or IT.

IBM stated in a recent white paper, "Smarter, Faster, Cheaper: An Operations Efficiency Benchmarking Study of 100 American Cities," that "All large organizations harbor inefficiencies. When IBM embarked on its transformation program in the early 1990s, the company eliminated $6 billion in costs, primarily by simply being smarter about what we did and how we did it."[4]

By being smarter, faster, and cheaper—as IBM did when facing its own economic troubles in the 1990s—companies functioning in these difficult economic times enable themselves to remain competitive in their bids to win new work while enticing existing clients to come back for more. This is something Mathematica constantly strives to achieve.

1.1.3 Cutting Budgets, Expecting Quality

The social science research community should expect to see its budgets cut, or at the least to remain frozen, for the foreseeable future. Despite the flat or reduced funding, there will be no cuts when it comes to the expectation of receiving top-quality results from our clients.

In a letter from Jeffrey Zients, acting director of the Office of Management and Budget, to Vice President Joseph Biden, in his role as President of the United States Senate, as part of the "Statistical Programs of the United States Government, Fiscal Year 2011" report, Zients stated:

"As we aim to tackle longstanding challenges in an era of scarce resources, it is especially critical that we support our ongoing efforts to provide unbiased, reliable, and timely data. Having access to quality, unbiased data allows us to make reasoned, disciplined decisions about where to target our

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[1] Kolakowski, Nicholas. "CIOs Need to Address CEO Concerns in Major Ways: Gartner." *eweek.com*, October 21, 2010. Available at http://www.eweek.com/c/a/IT-Management/CIOs-Need-to-Address-CEO-Concerns-in-Major-Ways-Gartner-371815/. Accessed February 14, 2012.

[2] Kolakowski 2010.

[3] Kolakowski 2010.

[4] Edwards, David. "Smarter, Faster, Cheaper: An Operations Efficiency Benchmarking Study of 100 American Cities." IBM Global Business Services White Paper. Somers, NY: IBM Global Services, February 2011. Available at ftp://public.dhe.ibm.com/common/ssi/ecm/en/gbw03132usen/GBW03132USEN.PDF. Accessed February 14, 2012.

resources to get the biggest return for our investment, and to identify where we've been spending consistently but yielding underperforming results."[1]

The total spending in non-Census years on supporting federal statistics is just 0.02 percent of the entire United States gross domestic product.[2] However, the estimated budget requested for fiscal year 2010 to carry out all fiscal year 2011 statistical work involving the 13 agencies whose principal missions revolve around statistical activities, plus the 80 other agencies that carry out statistical activities as part of their program missions, was $6.8 billion.[3]

Federally sponsored statistical work might account for just a small part of our overall government expenditures, but government officials are looking to cut budgets of all agencies across the board. "My committee went line-by-line through agency budgets … to negotiate and craft deep but responsible reductions in virtually all areas of government," said House Appropriations Committee chair Hal Rogers in a statement quoted by CNN in April 2011.[4]

Zients' statement also recognizes the push by federal agencies to gain the best possible research return on their investments. We see no evidence why privately funded foundations or individual state agencies also conducting similar research would not expect the same results in this era of scare resources.[5]

1.2 Challenge: Implementing Efficient Data Collection Efforts in a Budget-Conscious Economy

One of the primary challenges faced by the Computer-Assisted Interviewing Support Group (CAISG) at Mathematica is handling multiple types of Blaise data collection efforts and at the same time remaining cost-conscious. We work with a wide variety of computer-assisted telephone interviewing (CATI), computer-assisted personal interviewing (CAPI), and computer-assisted web interviewing (CAWI) projects, some of which are conducted simultaneously across these multiple data collection modes. Several of these projects have also provided us with innovative and forward-thinking data collection designs, which our internal researchers and external clients have brought to our attention.

1.2.1 Meeting Expectations While Remaining Within Budgetary Constraints

Completing a project efficiently is one of the major issues computer-assisted interviewing (CAI) programmers consider when taking on a challenging Blaise-based data collection task. Ideally, we would all have as much time as necessary to troubleshoot and try out new concepts, but in the business world that is not possible and definitely not an efficient use of potentially scarce programming time. Time equals money and time not properly spent is a client's budget wasted.

Our primary goal is to persuade programmers to apply out-of-the-box Blaise solutions as much as possible. However, when we cannot do so we look to develop custom applications with an eye toward designing them with as much reusability potential built in as possible.

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[1] Zients, Jeffrey D. "Statistical Programs of the United States Government, Fiscal Year 2011." Washington, DC: Office of Management and Budget, 2010. Available at http://www.whitehouse.gov/sites/default/files/omb/assets/information_and_regulatory_affairs/11statprog.pdf. Accessed February 14, 2012.

[2] Zients 2010.

[3] Zients 2010.

[4] Riley, Charles. "2011 Budget Cuts Revealed." money.cnn.com, April 12, 2011. Available at http://money.cnn.com/2011/04/12/news/economy/2011_budget_cuts/index.htm. Accessed February 14, 2012.

[5] Zients 2010.

We might have built some of these custom applications thinking they would be feasible for only one project's purpose, but they later developed into valuable tools we have repeatedly applied to other projects, ultimately saving on new development costs. We realized such a benefit because we kept this reusability concept in mind at the start.

1.2.2 Remaining Innovative and Forward-Thinking

If all CAI projects were exactly the same, our work would be boring and devoid of challenges; but, as we all know, very few actual projects are exactly the same, in spite of what the client tells you! There are always opportunities in which we have the chance try out new data collection concepts or improve upon existing ones, as long as we find a budget-friendly way to implement them.

Mathematica's CAISG strives to remain innovative, forward-thinking, and cost-effective. One of the areas in which we have developed expertise involves the use of real-time processes. In these cases, data collected from other systems are accessed and written to by the Blaise instrument immediately, rather than through the use of an external series of off-hours processes. These real-time processes in turn facilitate the simple synchronization of data between disparate systems: for example, a Blaise instrument collecting data linked to a SQL-based sample tracking database.

We have also developed an area of expertise in programming multimode instruments with a unimode design—for example, a CATI/CAWI instrument that shares one .bla and .bdb file.

Whether it be the out-of-the–box, built-in capabilities of Blaise or integrating it with custom applications, you can balance your data collection innovations, apply your allocated and limited programming resources to the data collection tasks at hand practically, and wind up being cost-effective for your clients.

2 Benefits of Using the Built-In Capabilities of Blaise

In our quest to balance cost-efficiency with forward-thinking data collection solutions, Mathematica's CAISG has used the Actions and Events capabilities of Blaise to produce dynamic and reusable applications. Their flexibility facilitates the easy synchronization of external systems with data collected in our Blaise instruments, resulting in reduced development costs. We have also used Actions to implement a system in which one instrument updated data in a second instrument before launching it in the data entry program (DEP). Lastly, we have extensive experience programming multimode surveys using one instrument and one centralized database because of the capabilities available to us right out of the box in the Blaise programming suite.

2.1 Actions and Events

Using Blaise's Actions and Events capabilities adds valuable functionality to our survey instruments. They enable us to seamlessly integrate external systems, such as our survey management systems, with our Blaise instruments. Their capabilities also enable us to incorporate other Blaise functions, such as executing a question-by-question look-up help file into an instrument's DEP session. We have used Actions and Events to invoke reusable component object model (COM) applications and out-of-the-box Actions, including calling Manipula and Maniplus programs from within the DEP. Although Actions and Events function differently they are similarly defined.

An Event can be linked to a data type using an Event handler defined in the data model properties file (.bdp). The COM object is referenced in the Event handler and is executed when the DEP encounters the field with the associated data type. The COM object specifies when to execute the code for the associated Blaise field by using the predefined methods of the application programming interface (API): pre-edit, executed when entering the associated field; edit, executed when switching to the edit mode; and post-edit, executed when leaving the associated field. We have used Events in our

instruments to execute COM objects that invoke external applications. We are able to reuse these custom-built COM objects for multiple projects.

Actions can be linked to a data type, but unlike Events they can be linked to a menu selection in the Blaise Menu File (.bmf) and can define the end-of-parallel behavior. In addition to calling COM objects, Actions can be specified to perform traditional DEP functions, such as executing Manipula programs and closing forms. The Blaise system has 49 predefined Actions originating from the traditional DEP menu.[1] We have Actions declared in our base instrument that we use as a starting point.

Events are used if the COM object should be invoked automatically at a specific time. Conversely, Actions are not automated, but are instead invoked by the user.

2.1.1 Invoking Built-In Actions

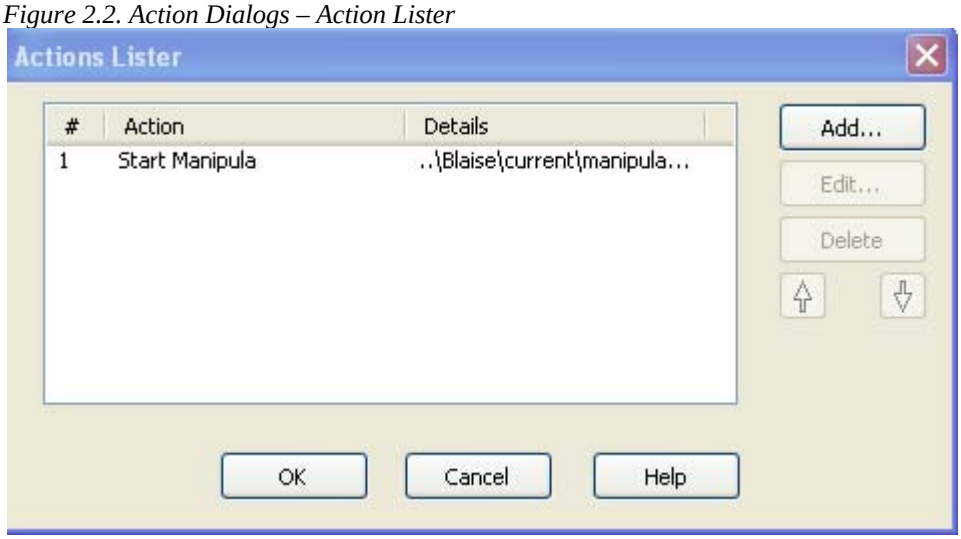
Based on the needs of a specific project, we discovered that using Blaise's built-in Actions to link two separate Blaise instruments was the most efficient way to conduct the project's data collection. The interview was split into two sections in which a selected respondent completed one section and another household member completed the second. We have also had similar projects in which one respondent acting as a proxy for another could complete a secondary survey. We decided that because each section had potentially different respondents it would be easier to manage CATI calling if the interview was separated into two instruments. Additionally, we had to link the instruments together because the logic for the second section depended on responses from the first. We used an Action to update data in the secondary instrument and to launch it in the DEP from inside the primary instrument.

To implement the transition from the primary to the second instrument, we linked an Action to a data type that executed a Maniplus program launching the second DEP. To invoke the Action, the interviewer clicks on a button located inside the input box of the field (Figure 2.1). Before launching, we defined an Action calling a Manipula program to import data from the primary instrument to the secondary instrument (Figure 2.2). Because the secondary instrument cannot function without the data from the primary instrument, we added an edit check to ensure the interviewer executed the update Action before the transition Action.

Figure 2.1. Input Box to Invoke Action

[1] "Predefined Actions." Blaise 4.8 Online Assistant. Available at http://www.blaise.com/doc/doc4.8/index.html. Accessed February 14, 2012.

Figure 2.2. Action Dialogs – Action Lister



2.1.2 Invoking Actions and Events Through COM Objects

In addition to invoking built-in Blaise Actions, it is possible to invoke COM objects in a Blaise instrument. Mathematica has built several COM object applications activated through Actions and Events, including a stopwatch and an error tracking system.

The stopwatch application is invoked as an Event linked to a specific data type. The application is automatically activated when the user lands on the associated field and deactivated by an Event within the COM object, in this case someone stopping the stopwatch. The timing collected by the stopwatch is captured and stored as a field in the data set.

The error tracking system links an Action with a selection in .bmf and calls an external application allowing the entire Blaise object to be available for the application to read applicable data via the Blaise API. These applications have served as a prototype launching pad for development of our larger systems.

2.2 Multimode Instrument Design

In our previous IBUC conference paper, we discussed our challenges and experiences with conducting multimode CATI and CAWI instruments sharing a centralized Blaise database.[1] Our multimode instruments use most of Blaise IS's out-of-the-box capabilities with minimal customization of Blaise's Internet Workshop settings, style sheets, and .asp pages in order to work with our authentication process.

We also use Blaise's Automatic Language Mapping capability to declare each mode as a separate instrument language. This enables both modes to share the same variables, field declarations, and logic in a single instrument. The capabilities also give the programmer the flexibility to specify unique text and logic for each mode. The end result is the ability to store all instrument data in one centralized Blaise database, thereby eliminating the need to transfer data between separate Blaise instrument databases. This single database storage also activates Blaise's case-locking mechanism so that a case can be accessed by only a single user in a particular mode. For example, a web user is not able to access a case that a CATI interviewer currently has open and vice versa. In this scenario, the locking mechanism and single database eliminates the dilemma of deciding which data should be used

[1] Hart, Leonard, Scott Reid, and Erin Slyne. "Challenges of Developing and Supporting Multimode Survey Instruments." Blaise Users Group website. Available at http://www.blaiseusers.org/2010/papers/6a.pdf. Accessed February 14, 2012.

if there is a conflict across modes, thereby maintaining data integrity and saving on additional programming and data reconciliation time.

2.3 Integrating with Custom Applications and SQL

Mathematica's CAISG has implemented two system designs in which external applications are seamlessly integrated with the DEP. One is a COM object used to execute stored procedures in a SQL database through an Action and the other is an on load Event in which the COM object interface loads automatically upon form selection.

2.3.1 SQL and Blaise

One of our continuing goals is to find ways for Blaise to communicate in real time with an external non-Blaise database, such as a SQL server database.

Several years ago, we explored the Blaise Datalink component and, although Datalink has the potential to be a powerful tool, it did not meet our all of our requirements. We needed the capability to store selected instrument data into a native Blaise database while simultaneously storing other selected data into a SQL database. Datalink provided only the capability to save all of the instrument data into a single SQL database. To meet our requirement of writing data once to a centralized sample management database, we needed the capability to share the SQL data tables that Datalink utilizes with non-Datalink SQL-based systems. Although Datalink can be flexible, it is rigid when it comes to sharing tables with other systems.

Our solution was to build triggers that listened to the Blaise SQL tables for updated data. When data were modified in the Blaise SQL database, the triggers would execute updates to the central tables used by our other systems. These triggers were also used to listen for and transfer data from the central tables to the Blaise tables.

Although our solution worked, the difficulty of supporting multiple databases and maintaining individualized triggers was inefficient and costly because of the additional programming time needed to document and implement them. To work around these limitations, we built an application that calls a COM object that executes stored procedures in the SQL server database to move data between the Blaise data set and our centralized sample management system SQL database. This design proved to be the most efficient and cost-effective way to proceed as we can control which specific instrument's data elements are stored in a particular necessary database. Through an easy-to-maintain COM object, we are also able to read and write data between the SQL servers and native Blaise databases. We built two stored procedures for use by our SQL databases to make this tool reusable and dynamic. One procedure accepts a listing of the Blaise fields where information will be exchanged and updated between the Blaise and SQL databases. The other procedure contains the SQL statements that move the data. Because the COM object is driven by the stored procedures, only the stored procedures have to be modified for a specific Blaise instrument.

2.3.2 On Load Event

A challenge encountered during our quest to implement real-time updates between systems was to build an instrument in which the COM object was automatically loaded upon the form's selection. It was suggested to use the predefined Events, in particular the "OnDialBegin" Event in the CATI specification file; however, we realized that this would work only for our CATI projects that used the call scheduling capabilities of Blaise and would not be applicable to our CAWI or CAPI instruments.

We tried to implement an alien router procedure in which individual parameters are passed between the DEP and the COM object, but discovered it would be difficult to maintain a list of parameters because our data models can often change, especially during the instrument development phase.

In order to establish flexibility and reusability, we decided to invoke the COM object using an Event linked to a data type. The external application was granted unlimited access to the entire Blaise survey instrument and data records. As a result, we can perform real-time updates seamlessly through the

Blaise API. No parameter declarations were required and the implementation by a Blaise programmer is straightforward. Using the Event handler, we specified the COM object method to execute at the pre-edit time using the "blrsPreEdit" property found in the API. The COM object is invoked immediately after opening a case and is completely transparent to the user.

Real-time updates, although powerful, carry risks such as increased data vulnerability if they are not implemented with caution. Because the entire Blaise data instrument and data set are available to the outside application, data can easily be modified unintentionally. In order to minimize this risk, we implemented explicit specifications and comprehensive test plans. Any changes to the system are thoroughly evaluated and carefully tested and when these guidelines are followed, the rewards easily outweigh the risks.

3 Areas We Are Exploring Using Blaise to Help Us Remain Cost-Effective and Efficient

The technologies available for use in survey data collection advance with each innovation that enters the marketplace. Recent innovations include the push for a national broadband plan;[1] always expanding and increasingly capable mobile devices (devices based on the iOS used for the iPhone and iPad and Android™ operating system); and improved ways for transferring data across multiple systems allowing for reporting in real time.

Implementing systems that use the latest technologies can be rewarding, but it is also risky and can have significant cost implications. Comprehensive planning, such as performing a detailed cost-benefit analysis, is essential to balancing the risks against the rewards of implementing successful and innovative systems.

In spite of the risks, there are new areas of technology in which we feel Blaise can have a strong impact on data collection process efficiency.

3.1 Real-Time Processing Using the Blaise Datalink Component and SQL Databases

The Blaise Datalink component in the Blaise 4.8 series allows for reading and writing of Blaise records to Object Linking and Embedding Database (OLEDB) data sources. Because this Blaise component is available, we can start planning the implementation of real-time processing between our survey management and data collection systems. As the data shared between these disparate systems become instantaneous and centralized, we can eliminate the scheduled data transfer and synchronization processes between these systems and instead provide up-to-the-second statistics of our data collection efforts to clients.

As previously mentioned, Mathematica tried using the Datalink component to share the SQL tables used for storing the data collected in a Blaise instrument with our survey management systems; although we were successful, it required substantial programming time and effort to implement. The end result produced an inefficient and costly system requiring intricately programmed updates to multiple databases. However, we plan to revisit the Datalink component as part of the plan for the upgrade to Blaise 5.

Because Blaise 5 will not store data in the current Blaise database (.bdb) format, we will have to link Blaise records collected in our instruments to another database structure. The current Datalink component enables us to design a system into which we can easily integrate our eventual Blaise 5 instruments that will be stored in the new database format.

[1] "Recent FCC Broadband Initiatives." Federal Communications Commission website. Available at http://www.fcc.gov/guides/recent-fcc-broadband-initiatives. Accessed February 14, 2012.

We also recently conducted an evaluation of our Blaise case management system to determine how to collect and process survey data as efficiently as possible. Because respondent sample information can be tracked and manipulated across multiple systems, it seems extremely inefficient to maintain data mirrored in distinct systems, which, if not properly handled, can easily get out of sync. After our success with using a SQL server database to communicate with Blaise, we decided to design and eventually implement a process that stores all respondent sample information in a centralized database shared by all the systems that need access to it. This would eliminate processes that update data on a scheduled (usually overnight) basis between systems and make updated information available to the interviewing process almost instantaneously.

By successfully using the Datalink component for our CAWI surveys by linking a .boi file on our web server with a .bdb file on our data server, we are operating with a secure, real-time processing system for our multimode CATI/CAWI data collection instruments. Using our past experience with the success of these .boi files and the expected advances of the Datalink component, we anticipate that our re-exploration will produce desirable, cost-effective, efficient, and innovative results.

3.2 Blaise on Mobile Devices

During the past decade, the wireless internet and mobile telephone markets have exploded in the United States and shows no signs of slowing down any time soon. According to the Pew Research Center,

"About four-in-ten Americans (41%) connect to the internet wirelessly using a laptop or hand-held device when away from home or work. This is up from 36% in April 2009. Far more Millennials than those in older generations use wireless connections to surf the internet. About six-in-ten Millennials (62%) connect to the internet wirelessly when away from home or work, as do 48% of Gen Xers.[1]

Because of this growth, especially when contacting younger survey respondents, clients are demanding that we offer new ways of collecting data from respondents who use the latest wireless and mobile devices. This has added complexity to our goal of remaining flexible but cost-effective and efficient.

Developing dynamic data collection systems to adapt to the seemingly endless variety of mobile technologies is an ongoing challenge. From January to December 2011, mobile platforms have gone from 0.7 to 1.2 percent of the browsing marketplace[2] and we expect this percentage to skyrocket in the years to come. From iPhones, iPads, and Android-enabled devices to tablets and e-book readers, each platform also has its own browser to support. In the near future we will have to determine how to design efficient, real-time systems that can optimize Blaise's data collection capabilities on mobile devices. It appears the trend in data collection is moving to an entirely internet-based system, in which one browser-based system that can handle many distinct types of browsers can manage CATI and CAWI (and possibly CAPI). Supporting the vast variety of browsers will be a challenge. We hope our experience with multimode data collection, especially in using Blaise IS, can give us a leg up as the world of mobile technology moves to the forefront of our data collection efforts.

[1] Keeter, Scott, and Paul Taylor, editors. "Millennials: A Portrait of Generation Next. Confident. Connected. Open to Change." Pewsocialtrends.org, February 24, 2010. Available at http://pewsocialtrends.org/files/2010/10/millennials-confident-connected-open-to-change.pdf. Accessed February 14, 2012.

[2] "OS Platform Statistics." W3 Schools website. Available at http://www.w3schools.com/browsers/browsers_os.asp. Accessed February 14, 2012.

4 Conclusions

Striving to be innovative, practical, and cost-effective should be key parts of any organization's business model if it wishes to remain economically viable in today's competitive marketplace. Through proper planning, applying innovative ideas and implementing complex data collection efforts should not be a difficult task, even when your funding is restricted or you face obstacles presented by a difficult economic climate.

Organizations have to look outside of themselves to companies that excel at change to help in spotting leading technology trends and how to adapt to them. If you look at companies that have been around a long time, such as IBM, you will see they had to change their business models just to remain in business. IBM has migrated from making business tabulating and time recording machines to being on the leading edge of computer technology today. If IBM did not change and evolve over the years it would probably be out of business today. Today, IBM makes none of the products it sold 100 years ago.[1]

Eastman Kodak is an example of a company that has not kept up with technology and market changes. Kodak struggled to stay relevant as the world moved from film to digital cameras and it is possible Kodak might go out of business in spite of all the innovative products it developed in the past. Kodak was once admired as a technical and marketing marvel, the gold standard of American business success for decades, yet it filed for Chapter 11 bankruptcy protection in early 2012 and has seen its worldwide workforce reduced from 130,000 in the mid 1980's to just 17,000 today.[2]

4.1 Remaining Cost-Effective in a Cost-Conscious Economy

The challenge to keep costs low while producing a quality product is very demanding in today's environment. One way of being cost-conscious is to build flexible and dynamic systems that can be reused repeatedly. This helps lower overall costs by spreading the cost out over several projects. Before building new features, we must research the use of out-of-the-box utilities to their maximum capabilities. If these out-of-the-box features do not meet the project's needs, we must figure out how we can add reusable value to them without re-creating the wheel.

Too often organizations are resistant to change and continually implement the same methodologies for all projects, regardless of cost and efficiency. Therefore, it is important for us to periodically evaluate the efficiency of our systems, determine if we are using the most suitable development tool(s) for each task, and decide if an update is necessary. The process of updating systems to keep up with changing technology can be expensive in the short term but cheaper in the long run.

4.2 Future Improvements

Technologies in the data collection field are continuously changing. In order for us to succeed, we have to design innovative systems and meet the needs of our clients while keeping our costs in line with or lower than our competitors. We have high expectations that the next generation of Blaise, version 5, will meet these demands and enable us to continue to add flexibility while writing code once and sharing data for real-time data collection and sample management in an easy-to-use fashion. Along with this, we must continue to develop reusable products that are sufficiently dynamic that they can be used with other systems.

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[1] "An Exploration into Making the World Work Better." IBM at 100 website. Available at http://www.ibm.com/ibm100/us/en/thinkexhibit. Accessed February 14, 2012.

[2] Sink, Steve. "Kodak Files for Chapter 11 Bankruptcy." *USA Today.com*, January 19, 2012. Available at http://www.usatoday.com/money/industries/retail/story/2012-01-19/Kodak-bankruptcy/52660342/1. Accessed February 14, 2012.

This leads us to future improvements we feel Blaise has to make to remain a leading product in the area of survey data collection. Datalink should have functionality for working with external databases that are defined outside of its default structure settings. The ability to write once and share between systems contributes to major cost savings and reduces data problems that could occur by moving data around. It will also be important for Blaise to run on any number of mobile devices. This market is growing and changing rapidly as people find new ways to use these devices in their everyday lives.

The bottom line is no organization wants to become the next Kodak.