



International Conference on Industry,
Engineering, and Management
Systems

March 24-26, 2014

Dear Conference Participants:

It is with pleasure that we present to you the Proceedings of the 2014 International Conference on Industry, Engineering and Management Systems (IEMS). The papers presented this year were of consistently high quality in their respective fields. The papers cover a wide range of topics in the business and engineering fields. The papers cover a wide range of topics in the business and engineering disciplines, integrating concepts that further the mission of the IEMS Conference.

We present this Proceedings to you in the spirit of continuous improvement. Your comments and suggestions regarding the continued improvement of the Proceedings are always welcomed.

These proceedings would not have been made possible without the valuable contributions of our Track Chairs for the time and effort they spent reviewing the papers; and for our Administrative Coordinator, Elki Issa, whose work behind the scenes helps make our Conference a success.

We look forward to seeing you at IEMS 2015!

Warm Regards,

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Government Accountability and Transparency Mobile Readiness

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Abstract

With the transition from government to e-government, greater transparency in government accountability has occurred. State government budgets and performance reports are voluminous and difficult to understand by the average citizen. There is a need for government Websites to promote public trust while providing understandable, meaningful and usable government accountability information. The public needs to have access to information that links the outcome of government spending so that government can be accountable for their spending. Since mobile device usage is increasing, users of these devices need for websites to be viewable from mobile devices which is known as mobile readiness. Mobile web readiness research was conducted to identify the degree to which government or rather e-government produces mobile friendly Websites using the World Wide Web Consortium (W3C) MobileOK check technology. At the time of evaluation, government transparency and accountability web assets are not mobile ready as only twelve of the fifty state transparency Websites evaluated scored over 50% using the mobile readiness criteria tested with the W3C MobileOK check technology. The research results are discussed along with a mobile checklist that was developed by the researchers as a guide useful to those that develop websites. These guidelines provide guidance on designing and building websites that are very easy to work with on mobile devices, without sacrificing any content or functionality due to device limitations. Future research efforts in government accountability and transparency and mobile readiness are also provided.

1. Introduction

With the transition from government to e-government, greater transparency in government accountability has occurred. State government budgets and performance reports are voluminous and difficult to understand by the average citizen. There is a need for government Websites to promote public trust while providing understandable, meaningful and usable government accountability information (Posey, 2006). The public needs to have access to information that links the

outcome of government spending so that government can be accountable for their spending. Since mobile device usage is increasing, users will access information from their mobile devices creating a need for websites to be able to be viewed from a mobile website referred to as mobile ready. Mobile web research was conducted to identify the degree to which government or rather e-government produces mobile friendly Websites.

The public needs to have access to information that links the outcome of government spending so that government can

be accountable for their spending (Carstens, Skies & Stockman 2014). The government has three fundamental functions for government which are accountability, budgeting and Policy-making (Posey, 2006). Accountability is strengthened when there is improved visibility into what government does, and how much it costs; a common managerial framework; connection of all costs to specific measurable activities accessible to the public through e-government sites. Budgeting can be addressed on e-government sites through providing increased visibility into performance budgeting by displaying individual activities and reconciling total costs to budget. Lastly, Policy-making is more effective through providing a basis for prioritizing spending and ensures alignment with legislative priorities; identification of areas for program/process improvement; a foundation for establishing realistic performance targets, benchmarks for government activities/agencies which can all be accessible on an e-government site.

2. Literature Review

Thornton and Thornton (2013) discuss the increasing demand by the public for government fiscal transparency by the public which can be accomplished through e-government sites. Curtin (2010) suggests that the federal government is still failing to meet the financial reporting needs of taxpayers and falling short of expectations based on survey findings on public attitudes toward government accountability and transparency given to 1,024 adults aged 18 and over in the United States. Content on e-government sites is a necessary link in bridging the gap in dissemination of information. Usability literature repeatedly addresses the importance of navigation menus, site maps, search tools, and help

documentation (Bonson-Ponte, Escobar-Rodriguez, & Flores-Munoz, 2008). Harris, McKenzie and Rentfro (2011) suggests from the results of their study to evaluate the accessibility of government reports, that many governments' performance information is difficult to find as users encounter challenges in navigating e-government sites. Panopoulou et al. (2008) use metrics to assess the usefulness of a site's navigation features such as having an internal search engine, site map or index, and placement consistency of navigation menus on each page. Since mobile devices are utilized by the vast population, the information on these sites must be viewable to everyone to include those that only have access to mobile devices.

The mobile web has presented the past challenges affiliated with desktops having small screen sizes to the similar challenge of users working with small screens on mobile devices (Nielsen 2009). Mobile interfaces are still challenged since the focus of mobile devices is to have lightweight and small devices for users to easily carry and move (Jeong and Han 2012). Burfurd and Park (2014) study findings suggest that extensive use of mobile device apps establishes a more selected and restricted view of information than that encountered in the open and expansive World Wide Web. Even though Nielsen (2009) recommends that a mobile site provide a link to the full desktop view Website, Jeong and Han (2012) suggests that mobile devices' screens are far too small to view a full site which is an unresolved challenge. A study by Church et al. (2007) examined 600,000 mobile device users over a 24 hour period and revealed that browsing was the dominant form of web information-seeking. Church and Oliver (2011) conducted a study of smartphone users and their access behavior and found a preference for native mobile applications (75%) rather than browsing or

searching the web. Kaikkonen (2011) investigated user behavior as mobile phones shifted to touch-based devices and the research suggests that user behavior shifted away from the use of 'mobile-tailored' websites back towards full websites and/or application use.

Therefore, the study presented focuses on mobile readiness which assesses Websites using the W3C MobileOK Checker Technology which is a machine based approach that provides the researcher with a percentage score of how well a Website performs on a mobile device using best practices established by the W3C. This is unique since the W3C is a well-known international organization that develops open standards to ensure the long-term growth of the Web (World Wide Web Consortium, 2014).

Al-Khalifa, H.S. (2014) used seventy evaluation criteria and incorporated the W3C MobileOK Checker against university websites in a study evaluating the technical aspects (loading speed, browser compatibility), interface (effective use of white space, icons are understandable), navigation (easy to use, no broken links), content and services (updated information, purposeful content) provided. Meeker (2013) suggests that mobile traffic as a percent of the overall global internet use is growing at approximately 1.5 times/year and this number is expected to accelerate. The public can use web resources that the government has created to keep government more transparent and accountable creating more trust in citizens with regard to their government (Bertot, Jaeger & Grimes 2012).

3. Methodology

The focus of the study was assessing the mobile readiness of government accountability and transparency sites. This was a machine based approach that leveraged the W3C

MobileOK Check Technology to understand how well the sites present themselves in a mobile world. Therefore, the machine based approach, use of the W3C MobileOK Check Technology, was the method used to obtain the mobile readiness of each of the fifty state transparency websites tested. The W3C MobileOK Check Technology is centered on the standards defined in the Mobile Web Best Practices document from W3C (2014).

The recommendations refer to delivered content and not to the processes by which it is created, nor to the devices or user agents to which it is delivered. It is primarily directed at creators, maintainers and operators of Web sites. Readers of this document are expected to be familiar with the creation of Web sites, and to have a general familiarity with the technologies involved, such as Web servers and HTTP. Readers are not expected to have a background in mobile-specific technologies.

The machine based approach delivered a final score, in terms of percentage on a 0 to 100% scale, of the web asset that could be broken down into four groups based on either the failures per severity or category. The failures per severity are broken up into Critical, Severe, Medium and Low. Regarding the analysis, all failures carry the same weight for scoring purposes, but when it comes to understanding how severe the failures are, this is when the data becomes relevant.

In this approach each severity carries the following meaning:

- 1) Critical: A failure is critical if most mobile devices will not be able to render (part of) the page or will not be able to render the page in a reasonable time frame. Critical failures should be addressed first.
- 2) Severe: A failure is severe if most mobile devices will render the page but the user experience is strongly impacted.

- 3) Medium: A failure is considered medium if a mobile constraint has not been taken into account or the page relies on implicit hypotheses that could turn out to be wrong. For instance, a more conservative use of the network is possible (e.g. whitespaces account for more than 10% of the size of the page) or the character encoding is not explicitly set in the page.
- 4) Low: A failure is low if useful improvements are possible. For example, when the width and height attributes are not specified on an image, browsers need to reflow the page when the image has finished loading which may disrupt the user experience.

In addition, there are two other severities that are part of this, but do not affect the score of the site which are listed below:

- 1) Warning: A warning alerts authors on a point that may have an impact on the user experience on mobile devices and that may be worth checking. A warning does not necessarily mean that something needs to be fixed in the page.
- 2) Informational: An informational message is a lightweight warning that alerts authors on a point that may have an impact on the user experience on mobile devices if it is not handled with care. For instance, using scripting is not discouraged but authors should check that the page remains usable without scripting.

These two severities above provide an avenue for informative warnings which do not affect whether a test has passed or not. A warning is displayed to indicate that the technology could not be conclusively determined whether the content under test

conforms to a Best Practice. The warning may also just indicate that the content under test is close to violating a Best Practice and thus does not display as a fail.

The failures per category is broken down into categories. These categories are spread across 24 tests. Therefore, each category could have one or more tests. During the analysis of the page, if all tests for each category are passed, then a score of 100% is given. If not, then the ratio of how many passes out of the 24 tests is given as a percentage. The categories consist of rely on web standards, stay away from known hazards, check graphics and colors, keep it small, use network sparingly, HTTP errors, be cautious of device limitations, help and guide user input, optimize navigation, and think of users on the go.

With this breakdown, the "use network sparingly" category for example would test items such as did the page use caching, how many external resources are in the page and how big is the page. If new tests or categories are devised, research can easily be conducted to extend the existing work with the new areas of interest or relevancy to a particular domain. For example, banks could have a category for security on mobile devices that could be added on, with a supporting suite of tests to validate the category.

4. Results

Due to the volatility of the mobile industry and web technologies, the study results as a snapshot of a past time, versus a description of what is in existence in the world today. Advances in smartphone browsers and data speeds have made a lot of best practices obsolete as technology companies' work to bridge the gap, due to the pervasiveness of these devices. Advances in web technologies

refer to newly created Websites that are now mobile and desktop first natively. Since there is no longer a need for separate web assets depending on the device utilized, features such as support detection as opposed to device detection are becoming the norm.

Table 1 displays the numeric score for each state’s accountability and transparency Website in terms of how mobile ready the sites are based on the score calculated from use of the W3C MobileOK check technology. At the time of evaluation, most of the government accountability and transparency web assets were not mobile ready as only 12 states out of 50 scored over 50% for an overall mobile readiness score using the W3C MobileOK Check Technology. The individual scores varied due to the degree with which the Website was easily rendered within a reasonable time frame (externally linked resources which was common throughout many of the Websites result in a longer load time for a page), variation of page size limits (a fail was given if a page exceeds 10 kilobytes), consistency or inconsistency with the type of navigation provided throughout the Website, web content displayed was very specific as mobile device users need specific versus browsing type content, etc. The descriptive statistics for the research is that the mean for the mobile readiness score for the fifty Websites evaluated was 24.14. The median was 9.5 and the standard deviation was 29.28 that further demonstrates the need for greater focus of these sites to be able to be compatible with mobile devices.

Table 1. Individual State Mobile Readiness Scores

| State | Percentage Ready / 100 % | State | Percentage Ready / 100 % |
|-------|--------------------------|-------|--------------------------|
| AK | 13 | MT | 38 |
| AL | 33 | NC | 0 |
| AR | 0 | ND | 55 |
| AZ | 12 | NE | 16 |
| CA | 55 | NH | 0 |
| CO | 0 | NJ | 10 |
| CT | 0 | NM | 0 |
| DE | 3 | NV | 0 |
| FL | 0 | NY | 78 |
| GA | 7 | OH | 75 |
| HI | 39 | OK | 0 |
| IA | 4 | OR | 0 |
| ID | 52 | PA | 0 |
| IL | 78 | RI | 80 |
| IN | 9 | SC | 83 |
| KS | 70 | SD | 20 |
| KY | 0 | TN | 78 |
| LA | 72 | TX | 79 |
| MA | 6 | UT | 0 |
| MD | 0 | VA | 0 |
| ME | 14 | VT | 32 |
| MI | 0 | WA | 7 |
| MN | 0 | WI | 5 |
| MO | 23 | WV | 4 |
| MS | 36 | WY | 21 |

5. Discussion

A mobile checklist was developed by the researchers as a guide useful to those that develop websites that are mobile ready. The positive found from the W3C MobileOK Check Technology results of the fifty Websites tested was displayed into the mobile checklist developed since these mobile readiness aspects are desirable to obtain mobile readiness of Websites. However, the other portion of the mobile checklist is comprised of the negative found from the W3C Mobile Check Technology but rephrased in the guideline so that developers of Websites would be able to not mirror the problems found but rather eliminate a Website from these problems. The link between the W3C MobileOK Check Technology results and government accountability is that users of government accountability and transparency Websites along with users of any Websites can be mobile device users. Therefore, it is important that government accountability and transparency Websites be viewable to the public to cover the full spectrum of users of desktop to mobile devices.

There are ten tenets that summarize how to enhance a website to make it ready for mobile access. These guidelines were developed based on the research conducted to help web developers in the design of websites that optimize around the weaknesses and leverage around the strengths of mobile devices. The guidelines are presented below:

1. Consider users who are fully mobile:

These are users who are literally mobile, where they conduct their lives around mobile devices. They need to have their information compact and short.

2. Assist and direct users where input is required: Due to the limited screen real estate on mobile devices, manipulating the on screen keyboard, touch pad and other input parameters can be difficult. Therefore, there is a need to design and build sites that limit the need for input or assist the user with input.

3. Minimize network usage: Due to the limited bandwidth, and network speeds on mobile devices, it is important that websites be loaded and function with limited network requests. It is important for content to be cached or as a maximum loaded only once.

4. Minimize all content: Due to the limited bandwidth, and network speeds on mobile devices, it is important that websites have small payloads. Therefore, payloads could be content required per page such as images, video and text. Payload content should also be compressed for delivery onto mobile clients that are requesting pages of the website.

5. The colors and designs for all visual assets should be appropriate: Moving from a full 24-inch desktop monitor to a mobile device that has a 4 x 3 inch display, certain images and colors become easier or more difficult to view. Therefore, a web designer must make sure that

on mobile devices that visual assets still look good and convey the correct message.

6. Ensure that the navigation is effective and efficient: On a mobile device, it even becomes more important that users of a website are able to quickly access key information without too much time involved in navigating. This also ties into minimizing network use. Therefore, website navigation must get mobile users anywhere and everywhere quickly and directly.

7. Manage device support complexity: There are a multitude of devices on the market today. Although, these devices look similar, the differentiating factor is the various web technologies supported on the devices. In designing and building a website, be aware of these differences so that the website supports these different technologies.

8. Avoid obvious pitfalls and mistakes: Since mobile devices have small screens and even smaller keyboards, designing and building a website that avoids the known issues such as small navigation controls are imperative.

9. Always optimize around standards: Although there are a plethora of devices on the market, the similarity amongst all the devices is the support standards. The manufacturers of these devices work to satisfy these standards. Therefore, to ensure the most support across the board, it is important to design and build websites that are built on these same standards.

10. Always have a mindset for build once, deploy everywhere: Always design and build websites with the mindset that one code base will support different devices and the various limitations as opposed to having a specific code base per device. This mindset will allow for a website to be very maintainable.

The websites with the lowest scores for mobile readiness possessed a number of similar traits. One of these is that they all had at least

one failure per severity. There are a minimum of one critical, high, medium and low severity failure, and in most cases multiple failures per severity. Conversely, sites with much higher scores would only have medium and low severity failures. Therefore, the Websites with the higher percentage mobile readiness scores require less changes to the Website in order to be W3C compliant. These sites were also already very consumable over mobile devices and these changes would only increase an already positive user and functional experience. The higher scoring sites were much better about using the network sparingly, as their page was served over the wire and closely followed standards as much as possible. In addition, it was clear that accessibility was greatly considered in the development of these pages, which contributed to the number of tests passed and the overall high score of these Websites. The majority of the higher percentage mobile readiness scores of 50% or higher had problems with the categories of rely on web standards, stay away from known hazards, keep it small and use network sparingly.

The low scoring Websites were void of standards such as what character encoding the page is in, using CSS rules that are not supported across devices or failing validation for a specific declared document standard. These Websites also had a large download footprint with no use of caching, which was further compounded by the fact that these pages contained a host of links to external sources that did not always work. These links waste valuable load time that the mobile device could be using to perform other actions. Accessibility support was lacking on these low scoring sites. This was evident due to issues such as popups or lack of ALT text and missing tag attributes that help describe what the item is, but also

allow screen readers and other accessibility tools to understand the page. Adopting some accessibility guidelines would help improve website usability across mobile devices.

6. Conclusion

As mobile takes over and new standards emerge, developers need to be always adapting for the largest common denominators. The data contained on these sites needs to be viewed as a public utility, like water or electricity and as such should be freely accessible to most, if not all, the population. The results suggest that most of the web assets default on adhering to web standards, followed by avoiding known hazards and subsequently how they leveraged graphics and colors.

With the present study, future areas of research were identified. First, the guidelines developed need to be applied and tested to further validate the usefulness of the guidelines in terms of creating Websites that are very easy to work with on mobile devices, without sacrificing any content or functionality due to device limitations. The exploration of the development of innovative products that are mobile but without the limitations on the space of mobile web screens is another area of future research. Lastly, a survey to identify users' preference of an application to a mobile site would be useful to government and businesses. Within this survey, identification of whether a full site is preferred over a mobile site would also be useful and would point to challenges affiliated with existing mobile sites and full sites when used on mobile devices.

The adoption of any particular technology such as e-government sites will bring challenges regarding social, political, economic, and cultural implications (Zwick and Dholakia 2004). Therefore, developers of these sites will

encounter issues. However, learning will occur to eventually result in full resolution of addressing the original problem at hand, accountability and transparency in government.

7. References

Al-Khalifa, H.S. (2014), A framework for evaluating university mobile websites, *Online Information Review*, 38(2), 166-185.

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2012). Promoting transparency and accountability through ITC's, social media, and collaborative e-government. *Transforming Government: People, Process and Policy*, 6(1), 78-91.

Bonson-Ponte, E., Escobar-Rodriguez, T., & Flores-Munoz, F. (2008). Navigation Quality as a Key Value for the Webpage of a Financial Entity. *Online Information Review*, 32(5), 623-634.

Burford, S. & Park, S. (2014). The Impact of mobile tablet devices on human information behavior. *Journal of Documentation*, 70(4), 1-23.

Carstens, D. S., Skies, S. & Stockman, R. (2014). Achieving Useful Government Accountability and Transparency Websites. In D. Yannacopoulos, P. Manolitzas, N. Matsatsinis & E. Grigoroudis (Eds.), *Evaluating Websites and Web Services: Interdisciplinary Perspectives on User Satisfaction*. Niagara Falls, NY: IGI Publishing, 19-41.

Church, K., Smyth, B., Cotter, P. & Bradley, K. (2007). Mobile information access: A study of emerging search behavior on the mobile internet. *ACM Transactions on the Web*, 1(1), 1-38.

Church, K. & Oliver, N. Understanding mobile web and mobile search use in today's dynamic mobile landscape.; In *Proceedings of the 13th International Conference on Human*

Computer Interaction with Mobile Devices and Services of ACM. 2011, 67-76.

Harris, J. A., McKenzie, K. S., & Rentfro, R. W. (2011). Performance Reporting: Assessing Citizen Access to Performance Measures on State Government Websites. *Journal of Public Budgeting, Accounting & Financial Management*, 23(1), 117-138.

Jeong, W. & Han, H.J. (2012). Usability study on newspaper mobile websites, *OCLC Systems & Services: International digital library perspectives*, 28(4), 180-198.

Kaikkonen, A. Mobile internet, internet on mobiles or just internet you access with variety of devices?.; In *Proceedings of OZCHI*. 2011, 173-176.

Meeker, M. (2013), "Kleiner Perkins Caufield & Byers (KPCB) 2013 Internet Trends," Retrieved April 12, 2014 from <http://www.kpcb.com/insights?tag=Internet+Trends>.

Nielsen, J. (2009), "Mobile usability new research," Retrieved March 20, 2014 from www.useit.com/alertbox/mobileusability.html.

Panopoulou, E., Tambouris, E., & Tarabanis, K. (2008). A Framework for Evaluating Web Sites of Public Authorities. *Aslib Proceedings: New Information Perspectives*, 60(5), 517-546.

Posey, W. J. (2006). "Activity Based Total Accountability," Retrieved April 12, 2014 from <http://billposey.com/abta/>.

Thornton, J. B., & Thornton, E. (2013). Assessing state government financial transparency websites. *Reference Services Review*, 41(2), 366-387.

World Wide Web Consortium (W3C) (2014). Retrieved March 21, 2014 from <http://www.w3.org/>.

An Analysis of Factors Associated with Fraudulent Small Business Administration (SBA) Loans

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Abstract

This study analyzes risk factors identified in Small Business Administration (SBA) loan frauds over a 2-year period from February 2012 to January 2014, using data from the SBA website along with reports from the Office of the Inspector General. Identified factors will be discussed as part of a larger focus on risk assessment for accountants and auditors.

1. Introduction

The use of Small Business Administration (SBA) loans for fraudulent purposes is not new. In the 1960s and 1970s, reported scandals indicated that the mafia was using SBA loans for “front” businesses to obscure illicit activities. By the end of the 1970s, the SBA was commonly referred to as the “Small Scandal Administration” (DeHaven, 2011). To counter criticisms of promoting big business over the small businessman, Dwight Eisenhower signed legislation to create the SBA, despite his administration’s reservations that the SBA was “an uncontrollable program.” Created in 1953, the SBA replaced the Depression-era Reconstruction Finance Corporation, which lost support after allegations of influence peddling during the Truman administration.

Faring little better, the SBA’s problems began shortly after its creation with members of Congress using SBA money distribution to favor their constituents. Successive administrations continue to have problems. The Reagan administration’s policies contributed to the “Wedtech Scandal,” when

government officials knowingly assisted a corrupt defense contractor in fraudulently obtaining contracts through SBA minority set-asides. More recently, in 1986, Alaskan senator Ted Stevens won additional federal contracting privileges for disadvantaged or minority-owned small businesses through the Alaskan Native Corporation project (ANC), which instead went to large firms like General Electric and Lockheed Martin. In a 2011 investigative report, the *Washington Post* exposed the ANC and defense contract project improprieties. Ironically, *The Post* learned that the SBA thought it was the Pentagon’s responsibility to monitor the program, while the Pentagon said that responsibility remained with the SBA.

2. The SBA’s Approach to Fraud

According to the Small Business Administration’s website, the agency takes a three-pronged approach to eliminating fraud, waste and abuse. These include: (1) being proactive to prevent fraud before it can happen; (2) continuous monitoring of the SBA loan portfolio; and (3) strengthening enforcement by punishing offenders (SBA.gov).

Since the economy tanked in 2008, the SBA has been receiving more complaints about fraudulent claims made by consulting firms that promise to help small businesses apply for funds through SBA programs. Abusive practices include:

- High fees charged to small businesses by consultants that allegedly guarantee SBA funding programs. Most firms are told that these fees allow for preferred status to the small business. In fact, however, the SBA does not endorse or give preference to any specific private consultant or their clients.
- Bogus consulting firms that charge small businesses non-contracted service fees only after the client has submitted their bank account and routing information for processing.

Spurious threats and falsified communications from consultants that the small business will be ineligible for any SBA funding for three years via “forfeiture letters,” if they refuse to use the consulting firm’s services (Clough, 2010).

3. Data

The following details from the Office of the Inspector General address factors relating to fraudulent business loans from the Small Business Administration for a two-year period from February 2012 to January 2014. There were 56 cases. Of these, all were criminal investigations, except for two. The two cases, which resulted in civil settlements, were instances where employees of a company falsified information in order to enrich themselves with increased commissions or the benefits of selling a business asset.

Who are the perpetrators of these frauds?

| | # | % |
|--|----|------|
| Intermediaries, bank, or bank officer in the SBA loan programs | 18 | 32.1 |
| Small Business Owner (application) | 14 | 25.0 |
| Small Business Owner (down payment) | 7 | 12.5 |
| Small Business Owner (CRIMINAL felon background) | 4 | 7.1 |
| Company attorney OR Real Estate Attorney | 4 | 7.1 |
| Recruited individuals to apply for loan and get a kickback | 2 | 3.6 |
| Identity theft | 2 | 3.6 |
| Contractor or employee for the SBA committing fraud | 2 | 3.6 |
| Straw seller | 1 | 1.8 |
| Set aside contracts for veterans | 1 | 1.8 |
| Loan not used for correct purpose | 1 | 1.8 |

Remarkably, Table 1 shows that the greatest number of frauds were committed by the intermediaries, banks, bank officers, or bank presidents handling the loans. Despite popular belief, the US Federal Government does not lend SBA loans directly to business owners. Instead, loan proceeds are provided directly by banks and non-bank financial institutions that participate in the SBA program. Through loan guarantees by the federal government generally in the range of 75 to 85% of the loan amount, lenders approve loans to small businesses that would not have otherwise qualified under bank regulations (Heard, 2009).

Where did these SBA cases originate?

| State | # of cases | State | # of cases |
|----------------------------|------------|--------------|------------|
| Alabama | 4 | North Dakota | 1 |
| Arizona | 1 | Nebraska | 1 |
| California | 5 | New Jersey | 1 |
| Connecticut | 1 | Ohio | 1 |
| Florida | 2 * | Texas | 7* |
| Georgia | 1 | Utah | 1 |
| Table 2 (continued) | | | |

| State | # of cases | State | # of cases |
|---------------|------------|--------------|------------|
| Illinois | 4 | Virginia | 2 |
| Indiana | 1 | Washington | 1 |
| Kentucky | 2 | Wisconsin | 1 |
| Louisiana | 2 | Wyoming | 1 |
| Maine | 1 | TOTAL | 56 |
| Maryland | 5 | | |
| Massachusetts | 2 | | |
| Michigan | 2 | | |
| Missouri | 7 | | |

* Contains one civil settlement

Interestingly, as Table 2 shows, Missouri has the greatest number of criminal investigations by the SBA and other organizations. As mentioned in the previous discussion about SBA fraud perpetrators, most of the Missouri cases resulted from a very pervasive FBI dragnet case involving two bank vice-presidents and compliance officers that were prosecuted for their collusion with a former branch manager of the SBA in Springfield, Missouri. These individuals concocted a scheme to grant guaranteed loans to over 31 failing business owners that had significantly past due distressed loans with the two bankers. The bankers knew that the small businesses would also default on the new SBA loans, but the banks, as creditors, would receive some, if not all of the federal guarantee. In return for “curing” these bad debts at the banks, the SBA branch manager accepted bribes and kickbacks for proceeds that would help the banks’ liquidity.

As mentioned in the Missouri example and as shown in the data, joint investigations with other government agencies are quite common. In Table 3, when analyzing the total of 56 cases, the average number of agencies involved in each case was 2.3. Only 11 (or almost 20 percent) of the cases were solely investigated by the SBA.

About 48 percent of the cases were joint investigations with the FBI, while over 14 percent of the cases were investigated jointly with the IRS. Almost 11 percent were investigated in concert with the U.S. Postal Inspection Service and about nine percent were investigated in cooperation with the FDIC.

| Government Agency (total of cases does not equal 56 since multiple agencies worked on the majority of cases.) | # of cases | % |
|--|------------|------|
| Bureau of Alcohol, Firearms, and Explosives | 1 | 1.8 |
| Department of Health & Human Services | 1 | 1.8 |
| Department of Justice | 1 | 1.8 |
| Department of Labor Office of the Inspector General | 1 | 1.8 |
| FBI | 27 | 48.2 |
| FDIC | 5 | 8.9 |
| General Services Administration Office of the Inspector General | 1 | 1.8 |
| Homeland Security | 1 | 1.8 |
| IRS | 8 | 14.3 |
| Local police | 6 | 10.7 |
| Special Inspector General for Troubled Asset Relief Program (SIGTARP) | 1 | 1.8 |
| State police | 4 | 7.1 |
| U.S. Army Criminal Investigation Division | 3 | 5.4 |
| U.S. Immigration and Customs Enforcement | 1 | 1.8 |
| U.S. Postal Inspection Service | 6 | 10.7 |
| U.S. Secret Service | 5 | 8.9 |
| Veteran’s Administration Office of the Inspector General | 1 | 1.8 |
| No Joint agency | 11 | 19.6 |

Restitution for this two year period ranged from \$0 to \$52 million. The average amount of restitution was \$3,090,340. The incarceration sentence ranged from 1 day to 188 months, with the average incarceration being about 33 months. Six months of house arrest was only part of the sentence in three separate

instances. Probation periods for offenders ranged from 12 months to 60 months, with the average probation period being 38 months. Forfeiture of ill-gotten gains was rendered as part of the sentence in six cases with the mean amount being \$12,632,000.

4. Looking at the Fraud Case Facts

As mentioned in the most recent semi-annual report of the SBA to Congress, the federal SBA agency faces significant challenges of fraudulent schemes. There is a steady inflow of fraud case investigations at the SBA. During the last half of 2013, the agency saw 27 indictments, 28 convictions, and 26 new cases opened. While the agency touts the use of name checks, fingerprint checks, and background checks used by their program managers, as well as security clearances for SBA employees, the proactive dollar amount saved by not granting loans via name checks pales in comparison to the fraudulent recovery and forfeiture amounts identified by investigations, audits, and whistleblowers after the money has been loaned and is out the door.

While background checks are a noble start for cost savings of \$26,784,020 through proactive loan denial, this amount is only 0.15% of all the money loaned in 2013 by the SBA. Additionally, identification of irregularities and fraud through SBA audits of existing loans in 2013 was approximately \$42 million. Sadly, of the dollar amount of costs questioned in 2013 audits, only about 4% (or \$1,932,999) was actually collected (SBA Office of the Inspector General, 2013).

In 2013, SBA investigations (for post-lending fraud) identified cases of potential fraud recoveries of \$92,917,594 in addition to

\$185,659,456 in asset forfeitures. These fraudulent amounts identified, while impressive, account for approximately 80% of the agency's total cost-savings work output or accomplishments. As most accountants and auditors know, it is cheaper to build a strategy to monitor fraud proactively than to wait on the sideline and find it after the fact. Looking at the bigger picture, this post-lending recovery is only about 1.9% of the total amount of money loaned under the SBA's guaranteed loan programs during 2013. [This seems a bit low, given that the most recent survey published by Association for Certified Fraud Examiners claims that the typical organization loses 5% of its revenues to fraud each year and that the largest frauds are committed by business owners (ACFE,2012)].

5. Conclusion

The state of these challenges to SBA lending has recently resulted in an extremely critical Governmental Accounting Office (GAO) audit report, issued in September 2013, stating that a major problem with the agency is that the SBA has a pattern of starting new programs without gathering "information needed to assess their performance."

Despite the negative GAO report and criticism by members of the Senate Budget Committee regarding high default rates of 7(a) loans to bankrupt franchises like Quiznos, Cold Stone Creamery, and Huntington Learning Center, the SBA issued expanded eligibility to its two main loan programs, 7(a) and 504, beginning April 21, 2014.

While some members of Congress want the SBA to shift more risk to banks and spend more time assessing performance, the new eligibility

revisions will:

- Eliminate the personal resource test which benefits borrowers by adding flexibility in the management of their allocation of personal resources to the small business;
- Eliminate the nine-month rule for 504 eligible project expenses which allows businesses a longer timeframe in which to organize and initiate their small business project;
- Revise 504 loan program collateral requirements to allow Third Party Lender to take collateral in addition to Project collateral under certain conditions; and
- Enhance the corporate governance requirements for Certified Development Companies (CDCs), the nonprofit corporations that work with the SBA to provide 504 loans to ensure more board accountability and to reduce risks to the SBA portfolio.

Two of the best practices reported for lending partners who are preparing for an SBA audit are to monitor ongoing creditworthiness and have a procedure of self-monitoring (Coleman, 2012). From this author's research and given the GAO's audit recommendation, it would seem that the SBA needs to take this advice to heart and allocate some resources to determine how programs are performing before relaxing more controls.

6. References

ACFE (2012). Report to the Nation – 2012, On Occupational Fraud and Abuse. The Association for

Certified Fraud Examiners, 2012 (Retrieval online at <http://www.acfe.com/rtnn.aspx>)

Clough, M. (2010). Business Fraud Alert, BestBizPractices.org, April (Retrieved online at <http://bestbizpractices.org/business-fraud-alert/>)

Coleman, B. (2012). SBA Lender Risk Assessment and Reviews. The Coleman Webinar, Nov. 14 (Retrieval online at <http://www.colemanreport.com/wp-content/uploads/2012/11/112712DiagnosticsFINAL.pdf>)

DeHaven, T. (2011). Waste, Fraud, and Abuse in Small Business Administration Programs. CATO Institute, June 16 (Retrieval online at <http://www.cato.org/publications/congressional-testimony/waste-fraud-abuse-small-business-administration-programs>)

Heard, R. (2009). The Good, Bad, and Ugly of SBA Loans. Personal Finance Blog, August 16 (Retrieval online at <http://reginaldheard.hubpages.com/hub/The-Good-Bad--and-Ugly-of-SBA-loans>)

SBA.gov staff (2014). SBA website: Eliminating Fraud, Waste & Abuse. SBA.org (Retrieved online at http://www.sba.gov/about-sba/sba_performance/policy_regulations/eliminating_fraud_waste_abuse)

SBA Office of the Inspector General (2013). Semiannual Report to Congress, Fall (Retrieval online at [http://www.sba.gov/sites/default/files/\[c\]%20Fall%20SAR_2013.pdf](http://www.sba.gov/sites/default/files/[c]%20Fall%20SAR_2013.pdf))

Staff, (2014). Revisions to small business loan program expands eligibility. Daily News Journal, April 10 (Retrieval online at http://www.dnj.com/article/20140410/BUSINESS/304100014/Revisions-small-business-loan-program-expands-eligibility?nclick_check=1)

“Ballistical” - A 2D Target Practice Simulator

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Abstract

“Ballistical” is a 2D target practice simulator written in the C# language using the Windows Presentation Foundation. The purpose of the game is to give the player a challenge of hitting a target with a variety of weapons. Obstacles of hitting a target include (but not limited to) physics of bullet drop, distance, projectile weight, recoil, and wind. In this work, we describe, develop and demonstrate “Ballistical” as a way to further stretch game development theory and practice using C# language and development environment. The game uses the irrKlang sound engine to provide ease of sound manipulation. irrKlang plays an important role of the wind sound, giving the player an audio statistic of how strong the wind is. Projectiles will have realistic physics, ricocheting off of objects, and making impact with other objects in the game. The game is easily customizable as the end-user has access to the resources the game accesses such as audio and textures.

1. Introduction

The game development community is becoming a very exciting area but yet sophisticated. The development and availability of new libraries and the popularity of target shooting games makes it a serious area of research. In this work, we were intrigued by the availability of useful libraries, which are imbedded within our various traditional Integrated Development Environment (IDE) [1]. This made the development of Ballistical really easy and fun. Ballistical is a 2D target practice simulation project that began out of enthusiasm. It started as a practice project – which would later be expanded, amongst inquisitive college students during their first year in college whose original

intention was to improve upon their game development skills. The game covers wind simulation, gravity, and its effects on projectiles fired from weapons. Each projectile is simulated to take in account wind, gravity, and collision during its cycle. Projectiles that hit surfaces at certain angles can ricochet, while others may penetrate.

2. Why Ballistical

By nature of gaming, you never know what the end result of a simple idea would entail and ultimately inspire. Besides being practice for game development, simulators and realistic games really bring the inner child out of us and this is the way it should go. By doing things because they are fun, we are devoid of typical worries when taking so seriously. By using our love for

something such as game, the rewards are usually endless and could include game development position later on in life, name recognition in the field, self-gratification, or maybe one can play a role in a serious and perhaps life-changing scientific/mathematical simulations in the future [2]. Furthermore, hardware is improving at a high rate, enabling complex simulations to be carried out to the point that some games actually have simulation aspects integrated within them.

3. Characteristic of Ballistical?

Initially, we planned on making the game have 3 dimensions while retaining the 2D view. The 3 dimensions would dictate the aim of the player's weapon. Along with 3D aiming, we planned on adding scenarios that the player would be immersed in, such as a hostage situation where the player had to hit the suspect without causing harm to the hostage, along with more elaborate target practice maps. This is currently the main power of the game engine as it allows for optimal performance and integration. In its current form however, Classes are hard-coded into the application and it would be better if they are read-in from files so the user can easily modify or extend upon the system.

4. Ballistical versus other 2D shooting games?

From a majority of 2D shooting/target practice games we have examined and played (mostly Flash based), they tended to

lack in actual ballistics modeling or physics-based projectiles [3]. This often leads to non-dynamic gunplay as projectiles had a linear path: position of the weapon to the point of impact. The chance of projectiles ricocheting off of surfaces or being affected by gravity were non-existent [2]. Another feature of Ballistical that helps visualize the path of projectiles is the projectile tracker, which draws the path of the projectile in real-time. Unlike some games that rely on a single function to calculate the entire path of a projectile [3], Ballistical processes each individual projectile in its own thread which carries out the calculations for that single projectile per-tick. This allows for truly simulated ballistics, as in reality, the path of



a bullet isn't already determined before it is even fired out of a gun, though its path can be approximated.

Figure 1: SFML or similar dedicated graphic library to carry out all the renderings. Performance issues and a lot of boilerplate code were prevalent to use WPF for the game.

5. The use of Windows Presentation Foundation (WPF)

The use of WPF was both simplistic and useful. First, it made the development very easy because it is within the Visual Studio IDE, which is already popular for non-games applications development [2]. As it was stated earlier, the original idea was simple as could be expected from a practice project although it developed into robust and practical project. Not much time was spent contemplating the pros and cons of different graphics libraries at the time of development and we thought that WPF [2] would easy option, though it doesn't lend itself for use in any complex games. With this observation, we have now concluded that the ideal choice would have been SFML [3] or a similar dedicated graphics library to carry out all the rendering. This is because performance issues and lots of boilerplate code were prevalent to use WPF for the game.

6. Results and future work

As stated earlier, Ballistical is very useful, but it can significantly be improved by tweaking a number of things. First, it would be more robust and efficient if the classes were not hard coded. To this end, and along

with 3D aiming, we planned on improving the scenarios that the player would be immersed in, such as a hostage situation where the player had to hit the suspect without causing harm to the hostage, along with more elaborate target practice maps. This is currently slowing down the power of the game engine as it does not provide for optimal performance and integration. That is because Classes are hard-coded into the application in its current form, but it would be better if they are read-in from files so the user can easily modify or extend upon the system.

To that end, we plan to turn the Ballistical into a 3D game in the near future once we put what we learn from this version to use. Ballistical would be a good project to begin practicing 3D game development with, just as it has helped me with 2D game development.

Finally, there's no doubt that practice makes perfect. Although Ballistical was a practice project of, it has contributed a good deal to the overall wealth of knowledge on game development. Many lessons were learned from the mistakes and will help when improving Ballistical and developing other projects in the future. We all have to start somewhere but typically don't end where we begin.



Figure 2: Projectile tracking with 605m distance, 27.12 ammo and 124.53 degree angle



Figure 3: Projectile tracking with use choices.

7. References

[1] "irrKlang." - *an audio library for C++, C# and .NET and high level 3D and 2D sound engine*. N.p., n.d. Web. 22 July 2014. <<http://www.ambiera.com/irrklang/>>.

[2] "Windows Presentation Foundation." *Windows Presentation Foundation*. N.p., n.d. Web. 21 July 2014. <[http://msdn.microsoft.com/en-us/library/ms754130\(v=vs.110\).aspx](http://msdn.microsoft.com/en-us/library/ms754130(v=vs.110).aspx)>.

[3] "Simple and Fast Multimedia Library." *SFML*. N.p., n.d. Web. 21 July 2014. <<http://www.sfml-dev.org/>>.

Best Practices in the Procurement Environment: Examining Recommendations from Internal Audit Reports

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Abstract

The purpose of this research was to seek value-added opportunities contained in the recommendations of 30 routine procurement audit reports of various governmental and not-for-profit organizations. This examination revealed similar obstacles to operational efficiency in both centralized and de-centralized purchasing structures, regardless of the mission of the organization. Risk reducing, targeted suggestions proposed by the internal auditors to management were designed to balance adequate controls for asset protection and maximum utilization of available resources. Included were best-practice approaches to training/policy compliance, technology utilization, policy change and communication solutions recommended after incorporating input received from operations level employees as well as independent, objective testing by the auditors.

1. Introduction

The research examined thirty internal audit reports, regarding procurement audits, published by various governmental entities and analyzed the value-added opportunities mentioned in the reports in order to present collective “best practices” in this area. Where possible, available Follow-Up Audit reports were examined to identify which suggestions were implemented and conclusions about the value-added potential and impediments within the procurement environment were developed. Although this study specifically addresses the procurement environment, similar value-added opportunities exist in other core functional areas such as finance and operations. By examining the implementation challenges to the procurement process, recommendations can be suggested to avoid such difficulties in other functional areas. Certain patterns of policy inefficiencies, compliance

inconsistencies, and training inadequacies emerge when parsing the audit reports of multiple types of governmental entities.

The research showed that the internal audit function is not simply a top-down inspection of the policies and procedures in place to ameliorate risk and improve efficiency and efficacy. Rather, internal audit can provide a means for the “end user” to become an active participant in policy and procedure development in order to bring about positive change within the organization. Internal audit’s role is to provide a way for management and operational workers to communicate effectively with one another through an independent third party, as reported through the internal audit report. Policies and procedures can be clarified as needed after being examined, tested, questioned and reviewed with independence and objectivity by the internal auditor, as well as with the assistance of operational

employees. Additionally, gaps in employee and management training programs can be identified and rectified to bring actual results in line with expectations.

2. Trends in Purchasing

The research showed that in many cases when the entity being audited had a centralized purchasing system, there was a tendency to want to de-centralize it. Just as often, if the entity had a de-centralized purchasing system, there was a tendency to want to centralize the system. Both tendencies seemed to stem from a sense of dissatisfaction with the current controls in place, arising from a fundamental misunderstanding of the capabilities of the existing program. However, as was borne out by the research, when management examined and implemented the recommendations contained in the internal audit reports, management was better able to find the proper balance between the controls and system capabilities. This allowed the clients to establish the flexibility needed to meet the specific demands of the entity and yet maintain the controls required to appropriately manage exposure to risks.

2.1. Centralized

Traditionally, purchasing systems have been centralized in nature. If employees needed to make a purchase, they would call someone in the purchasing department and ask them to order the item or request a purchase order to purchase the item themselves. This system does make it easier to maintain stricter controls over the manner in which the employees are spending money. However, this system can be cumbersome in large entities and highly inefficient for the purchase of small dollar items, routine purchases, and travel needs.

2.2. De-Centralized

As business environment has become more accepting of credit card purchases, there has been a movement away from the centralized purchasing systems of the past and toward more flexible de-centralized purchasing systems that utilize purchasing cards. With purchasing card (p-card) systems, employees are empowered to make small dollar, routine or travel purchases without the initial involvement of centralized purchasing departments. This has been especially helpful with employees that travel for work. It allows the employees to simply charge the necessary travel and report the expenses, instead of issuing travel advances or reimbursing the employees for personal money spent.

3. How audit reports were chosen

The research materials used for this project are all primary-sourced audit reports found online at the websites of the client entities covered in the reports. As illustrated in Table 1, a variety of governmental and not-for-profit entities were selected to show that the opportunities for improvement were similar in nature, regardless of the business source. To that end, reports were selected from 14 municipalities, seven counties, three colleges/universities, three federal government entities, two United Nations programs, and one public school system. To add further depth to the findings, reports for 18 centralized purchasing systems and 12 de-centralized purchasing systems were analyzed.

Table 1. List of Audit Reports

| CLIENT | CENTRALIZED/ DECENTRALIZED | TYPE OF CLIENT |
|--------------------------------|-------------------------------|----------------|
| COLORADO SPRINGS, CO | CENTRALIZED | CITY |
| PHILADELPHIA, PA | CENTRALIZED | CITY |
| EL PASO, TX | CENTRALIZED | CITY |
| TAMPA, FL | CENTRALIZED | CITY |
| SIoux FALLS, SD | CENTRALIZED | CITY |
| COLLEGE STATION, TX | CENTRALIZED | CITY |
| RIVERSIDE, CA | CENTRALIZED | CITY |
| SAN DIEGO, CA | CENTRALIZED | CITY |
| ARLINGTON, TX | CENTRALIZED | CITY |
| FAIRFAX COUNTY, VA | CENTRALIZED | COUNTY |
| FAYETTE COUNTY, KY | CENTRALIZED | COUNTY |
| SAN MATEO COUNTY, CA | CENTRALIZED | COUNTY |
| PUBLIC SAFETY CANADA | CENTRALIZED | FEDERAL |
| SPRINGFIELD PUBLIC SCHOOLS, MO | CENTRALIZED | PUBLIC SCHOOL |
| UNICEF | CENTRALIZED | UNITED NATIONS |
| UN RATIONS PROGRAM | CENTRALIZED | UNITED NATIONS |
| UNIV OF CALIF SB, CA | CENTRALIZED | UNIVERSITY |
| COLLEGE OF SOUTHERN NEVADA | CENTRALIZED | UNIVERSITY |
| CINCINATI, OH | DECENTRALIZED | CITY |
| MILWAUKEE, WI | DECENTRALIZED | CITY |
| ANCHORAGE, AL | DECENTRALIZED | CITY |
| PORTLAND, OR | DECENTRALIZED | CITY |
| COLLEGE STATION, TX | DECENTRALIZED | CITY |
| MECKLENBRG COUNTY, NC | DECENTRALIZED | COUNTY |
| BREVARD COUNTY, FL | DECENTRALIZED | COUNTY |
| SARASOTA COUNTY, FL | DECENTRALIZED | COUNTY |
| BREVARD COUNTY, FL | DECENTRALIZED | COUNTY |
| SANDIA NATL LABS | DECENTRALIZED | FEDERAL |
| US DEPT OF COMMERCE | DECENTRALIZED | FEDERAL |
| UNIV OF NEW MEXICO, NM | DECENTRALIZED | UNIVERSITY |

All of the reports selected for review were routine in nature and were all part of the regularly scheduled audit review of the procurement practices of the entity. Although the strengthening of controls would reduce the risk exposure for fraud and some of the reports indicated the potential for fraudulent activities, none of the audits were specifically conducted for the purpose of investigating suspicious transactions. The fact that possible fraudulent activities, such as employees splitting transactions to avoid exceeding spending limits, were revealed is illustrative of the value added by the internal audit function.

4. Recommendations in audit reports

As shown in Figure 2, the most prevalently reported areas needing improvement were employee training/policy compliance (37.5%), utilization of existing software capabilities (20.43%), the necessity of policy changes

(14.02%), and communication deficiencies within the organization (12.5%).

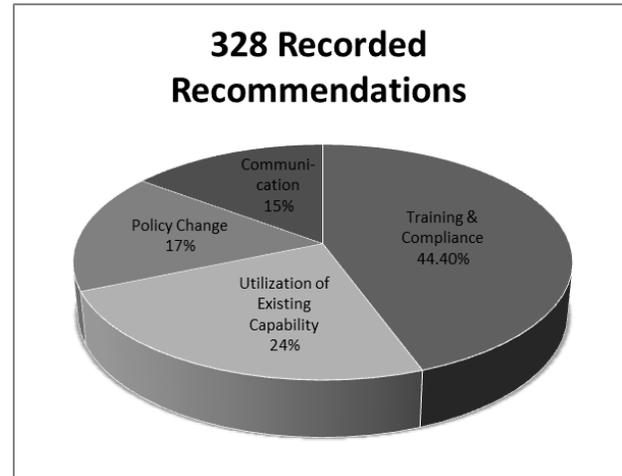


Figure 1. Recorded Recommendations

4.1. Training/policy compliance

For purposes of analysis, training and compliance recommendations are grouped together to elucidate the importance of the relationship between the two. Without properly training employees, policy compliance cannot be reasonably expected by management. The internal auditors were able to examine procurement policies and employee training programs and compare them to industry best practices. When sub-standard policies and programs were found, the internal auditors suggested targeted recommendations to management to assist with improvement. A 1996 study found that the number one reason for the success or failure of a p-card system was a lack of “internal marketing,” which is defined as explaining to employees about how the program works, including descriptions of appropriate purchases and where those purchases can be transacted (Visa International Inc., 1999). In the report of a 2013 audit conducted by the Office of the Inspector General (IG) on p-card activity at the US Department of Commerce, numerous practices were found that resulted in an unacceptable level of risk to the assets of the Department. The IG recommended that a rigorous training program be put in place to gain employee

compliance with existing p-card policies and procedures as they related to documentation, procedural issues and improper transactions. This training was not exclusively recommended for p-card users, but for all levels of management and operational employees to make certain that supervisors and approvers also understood their level of responsibility as it related to p-card usage (Katsaros, 2013).

4.2. Utilization of procurement software

Recommendations for the use of procurement software capabilities fell into two broad categories – either the entity did not make use of newly acquired software because the features were not understood or secondly, old software had not been properly configured to support the changes in purchasing control activities. In either instance, the efficacy of the program was hindered by a simple lack of awareness. UNICEF Procurement Services exhibited practices that covered both categories. UNICEF Procurement Services is a pooling program located in Copenhagen, Denmark, that buys medicines and other health related supplies for the United Nations and other NGO's. In a one year period starting in 2010, the Supply Division grew by a staggering 32%, from US\$ 874 million to US\$ 1.2 billion. The internal auditors found that the procurement controls inadequacies within the program were primarily the result of manual tracking of expenses with the program Lotus Notes and no interface existed with the Agency's enterprise resource planning (ERP) system. Further, some hard copies of documents were still being kept in physical binders (Office of Internal Audit and Investigations, 2013). The documentation system for the entire procurement program was piecemealed together with a combination of outdated methods of hard copy retention and underutilization of existing technology capabilities. Despite the fact that the program already had the technology in place to track the documents all the way through the

procurement cycle with the ERP system, UNICEF had not fully implemented its use. As a result of the recommendations contained in the audit report, the Supply Division coordinated with IT Solutions and Financial and Administrative Management to review and merge the benefits of the existing systems, allowing for the removal of barriers to full implementation of the ERP capabilities.

4.3. Necessity of policy changes

It was commonplace to find audit report recommendations explaining that purchasing programs had evolved in practice, while the policies guiding those programs had not been updated to support that evolution. For example, the audit report from the City of Cincinnati disclosed that the p-card policy contained "several instances of redundancy, ambiguity, and vagueness" (Sundararajan, 2013). Auditors noted that when policies lack clarity, in these instances, there is a risk that employees fail to understand the policy's applicability to current practices and this increases the potential for disregarding purchasing policies as a whole. The inadequacies outlined in the Cincinnati audit report were the result of the rapid growth of the p-card system and procurement policies that had not kept pace with that growth. The Finance Department agreed with the recommendation that changes were needed to guide the employees and the Finance Department worked to update and revise the policies to reduce the inefficiencies and increase efficacy. The department further instituted a practice of continuous monitoring of the policy and included a mechanism for regularly reviewing policies ensure inclusion of future updates.

4.4. Communication within the organization

Several of the audit reports analyzed in this research project contained references to inadequate communication of procurement

policy changes and subsequent revisions. At the University of California, Santa Barbara, the audit report includes a recommendation that the Business and Financial Services “Ensure that departments have access to standardized or master agreement templates that include contract elements required for their specialized professional service categories” (Hartline, 2013). This came in response to findings that contracts issued by departments other than finance did not contain specific clauses required by State law and University policy. The omission of such clauses represented a contracting risk to the University.

In another case, the Contracting and Procurement Unit (CPU) for Public Safety in Canada was newly established at the time it was audited in 2010. The audit report noted, “...the absence of sufficient information and guidelines to support managers when exercising delegated spending authority (Public Safety Canada, 2010).” The auditors recommended that policies and procedures be effectively communicated to the employees to promote understanding and compliance and reduce the exposure to risk of asset mismanagement or loss. Management responded to the recommendations by implementing a plan whereby information sessions would be held routinely with a focus on providing a clear understanding of policies and responsibilities of the decision makers within the Unit.

The audit report also provides the means for communication in two directions at once. Not only does management have the opportunity to assess the controls, but operational employees are given a voice as well by including feedback from those employees in the final report distributed to management. In a report based on the audit of the Facilities Management Department (FMD) in Fairfax County Virginia, the findings state, “FMD developed and utilized a Purchase Request form as a departmental control over blanket purchase orders; however, the use of the form

was inconsistent. Per FMD staff, the form was not used for recurring services such as security and custodial fees, and was available but not required for other purchases (Fairfax County Internal Audit Office, 2011).” This knowledge provided management with the information to create a more functional system that would be used appropriately by the staff. The audit of procurement in the City of Philadelphia found that “To ensure proper human-resource management and comply with city civil service regulations, we recommend that Procurement Department management make certain annual performance evaluations are prepared for all civil service employees under their supervision (Butkovitz, 2011).” This finding and recommendation was of great benefit to the operational employees. By not completing their annual reviews, employees were not receiving annual pay raises and other incentives such as the ability to compete for promotions. Finally, positive feedback for operational employees can also be communicated in the audit report as demonstrated in the Brevard County, Florida, “We recommend that the Accounts Payable function continue their diligence on ensuring that invoices are paid timely in accordance with AO-33..... (Internal Auditors of Brevard County, 2009).”

5. Conclusion

The research conducted for this project consistently displayed that open communication between management and operational employees facilitated clarification of policy for improved efficiency and efficacy of the organization. Through the findings cited in the audit reports, management gains an objective assessment of the efficacy of the controls in place as well as targeted suggestions for improvement based on industry best practices. Using that information a determination can be made regarding how improvements can be implemented.

Although the research for this project focused solely on procurement areas for these

entities, all of the recommendations contained in the reports could be applied to other functional areas of the organization as well. It is not hard to imagine that in today's dynamic marketplace that other functions of the entity, such as finance or marketing, might also have problems with full implementation of technology or keeping policies in step with procedures. Additionally, all functions of the organization can benefit from the openness of communication conveyed within the audit report and should utilize the report as a tool to facilitate the betterment of all levels of the operation.

Visa International Inc. (1999). Study Provides Best Practices for Purchasing Cards. *Modern Purchasing*, 41(3), 9.

6. Works cited

Butkovitz, A. (2011). *Procurement Department Auditor's Report*. Philadelphia: City of Philadelphia.

Fairfax County Internal Audit Office. (2011). *Facilities Management Department Procurement Practices Audit Final Report*. Arlington: Fairfax County Virginia.

Hartline, S. (2013). *Procurement and Contracting Risk Assessment & Contract Compliance Review*. Santa Barbara: University of California, Santa Barbara.

Internal Auditors of Brevard County. (2009). *Internal Audit of Purchasing and Contract Compliance*. Viera: Brevard County, Florida.

Katsaros, A. (2013). *Internal Control for Purchase Card Transactions Need to be Strengthen*. Washington DC: Office of the Inspector General, Department of Commerce.

Office of Internal Audit and Investigations. (2013). *Internal Audit of Procurement on Behalf of Other Organizations and Governments by Supply Division*. New York: unicef.

Public Safety Canada. (2010). *Internal Audit of Contracting and Procurement (Goods and Services)*. Ottawa: Government of Canada.

Sundararajan, L. (2013). *Procurement Card Program Audit*. Cincinnati: City of Cincinnati.

Business Process Modeling Tools within the Business Process Management Body of Knowledge

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Abstract

Business Process Modeling is part of operational excellence programs, including Lean and Six Sigma. Business Process Modeling tools that are part of the Business Process Management Body of Knowledge include the following: Process Maps with Swim Lanes, Business Process Model Notation (BPMN), Event Process Chain (EPC), and Value Stream Mapping. This paper will describe these business process modeling tools and show case study examples of the tools, comparing and contrasting the advantages and disadvantages of each tool, and where they can be best applied.

1. Introduction

Business Process Management is a disciplined approach to analyze, document, measure, monitor and improve business processes, with the goal of achieving consistent, targeted results aligned with an organization's strategic goals. (Chang, 2006) To enable the modeling, analysis and improvement of business processes, the processes must be modeled to gain a common understanding of how each process is actually performed in an organization.

2. Background of Business Process Modeling tools

A model is an abstraction of something for the purpose of understanding it before building it (Rumbaugh, et al, 1991). Models can be: mathematical, graphical, narrative, physical or a combination of these (abpmp.org, 2014). In Business Process Modeling our models will be mostly graphical and narrative.

Business Process Modeling helps us to manage and understand our processes; enables analyzing process performance; can help us to identify a future target state; and enables process improvement. Process modeling has many benefits to an organization. Process modeling provides a common symbol set, language and technique through which to communicate the understanding of processes. It provides consistent process models in form and meaning,

which helps to simplify process design, analysis and measurement. Depending upon the tools used, process models can be designed in a tool that can also be used to build the business rules and execution of the processes within the Business Process Management Software (abpmp.org, 2014).

There are several key data elements that should be collected when modeling processes, including: inputs and outputs which describe the information, materials, supplies, equipment, etc. that is used within the process activities; events that occur during the activities, and results of the activities; defining whether activities are value added, providing value to the customer, or non-value added, an activity that a customer would not be willing to pay for; roles and the organizations that perform the process activities; data and information used within the process activities; probabilities of process events occurring; queueing, arrival patterns, servers and distributions which provide an understanding of how customers are served in a process, or how a product moves through a process; the time that it takes to complete the steps in the process; the delays and wait times in the process that causes inefficiency; costs of the process; and business rules that define the way that the process should be performed.

Regardless of the specific process modeling tool that is applied, it is important to

define the standard notation that will be used to model the processes. The purpose of a standard notation is to provide a common understanding to communicate the models. The notation simplifies the design, analysis and measurement of the processes, and enables the ability to re-use activities, groups of activities, and even entire processes throughout the organization. The notation also provides the ability to import models into a Business Process Management Software tool, to enable process management and execution (abpmp.org)

3. Business Process Modeling Tools

There are several business process modeling tools included in the Association of Business Process Management Professional's body of knowledge, BPM CBOK® (www.abpmp.org). This paper will provide an overview of the following four tools: 1) process maps with swimlanes; 2) Business Process Modeling Notation Business Process Diagram; 3) Event-Process-Chain Diagram; and 4) Value Stream Map. Each of the tools have different notations, advantages and disadvantages, which will be discussed. This section will also provide an example of each tool for the reader to be able to compare and contrast the tools. The first three tools will use an Emergency Department's Lab Process, and the Value Stream Map example will be of a Healthcare Women's Services Center Screening Exam Process.

3.1 Process Maps with Swimlanes

A process map is a simple tool used to graphically capture the way that a process works. It is a great tool to document the current process, and walk through the process to understand how it is performed. It can also be used to brainstorm and design a future state or improved process as well. It is powerful due mainly to its simplicity and visual elements. It can convey the activities performed and their sequence, the inputs, outputs, process owners and information systems used within the process. The process map should be used as a means to understand and analyze the process. The boundaries and scope of the process map should come from the purpose of the map and the

objectives of the initiative. The process map should be generated by those people most familiar with how the process works. It is critical to actually walk through the actual process at the workplace where the work is actually performed. The process mapping symbols, most commonly used are shown in Table 1. A sample process map is shown in figure 1.

The steps to completing a process map are:

1. Identify level (one, two or three) to map and document
2. Define the process boundaries
3. Identify the major activities within the process
4. Identify the process steps and uncover complexities using Brainstorming and Storyboarding techniques
5. Arrange the steps in time sequence and differentiate operations by symbol
6. Validate the Process Map by a "walk through" of the actual process and by having other process experts review it for consistency

| Symbol | Name | Meaning |
|--------|---------------------|---|
| | Activity or Task | An action that performs work. |
| | Start or Stop / End | A symbol used to signify the start or end of a process map. |
| | Decision | Used when there is a decision to be made in the process. |
| | Sequence Flow | Connects activities within a process which shows the order of tasks. |
| | Paper document | A paper document, such as forms or reports. |
| | Sub-process | A sub-process designates a separate process that will be documented in a separate process map. |
| | Swimlane | Swimlane is a sub-partition of a process, grouping the activities performed by the same function. |
| | Off-page connector | Connects the process to another process map page |
| | On page connector | Connects a process step to another process step on the same page. |

Table 1 Process Maps with Swimlanes Symbols

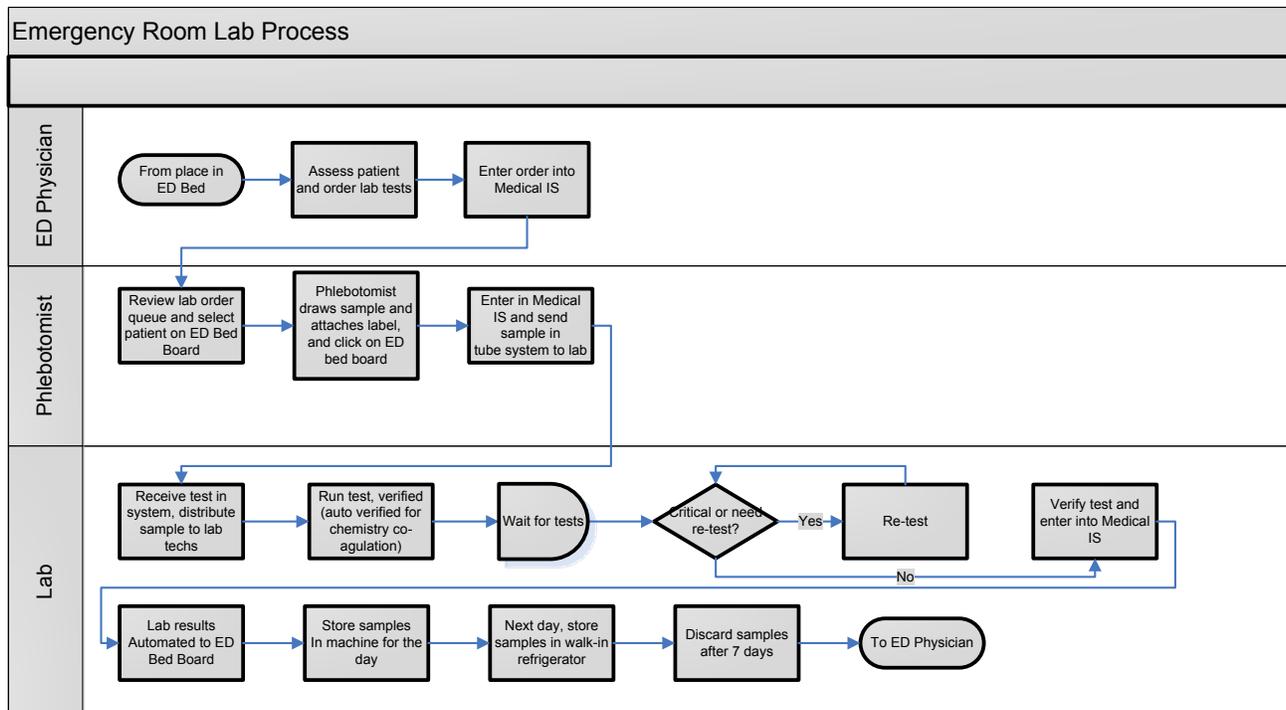


Figure 1 Sample Process Map with Swimlanes

3.2 Business Process Modeling Notation (BPMN)

Business Process Modeling Notation was developed to create a common notation for business process modeling. It also enables XML (web-based) and Business Process Management

Suite connectivity. The main modeling diagram in BPMN is a Business Process Diagram. Common Business Process Modeling Notation symbols are shown in table 2.

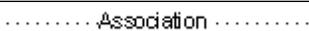
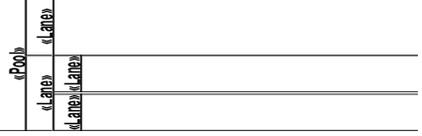
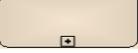
| Symbol | Name | Meaning |
|---|--------------------|--|
|  | Activity or Task | An action that performs work |
|  | Event | A signal that something happened, which changes the state of a process |
|  | Gateway | Branches, decision, split, merge, or join that controls the flow of activity |
|  | Sequence Flow | Connects activities within a process which shows the order of tasks |
|  | Message Flow | Shows the flow of messages between participants |
|  | Association | Associates information with objects |
|  | Pool Swimlane | Pool is a graphical representation of a participant in a process. Swimlane is a sub-partition of a process, typically grouping the activities performed by the same function. |
|  | Data object | Information involved in a process, as an input to an activity, or an output from an activity. |
|  | Sub-process marker | Marks a group of activities that is typically describe in a separate process |

Table 2 Business Process Modeling Notation Common Symbols

BPMN is similar to the swimlane process map discussed in the prior section, but has more explicit symbols and notation. An example of a BPMN Business Process Diagram for a Hospital’s Emergency Room lab process is shown in Figure 1. The process starts at the open oval on the top left of the process map, when the ED Physician assesses the patient and orders lab tests. The process flows from top to bottom, and left to right. The ED physician enters the order into the Medical Information System. The lab order represents a data object. The phlebotomist reviews the lab order queue and selects the patient in the ED Bed Board system. The phlebotomist then draws a sample and attaches

the label, then clicks the ED Bed Board system to initiate the next process step. She enters the sample information into the Medical Information system and sends the sample to the lab via the lab tube system. The lab receives the test in the system, and distributes the sample to the lab techs. The lab tech runs the tests, and verifies the results. An event signifies a decision point of whether a critical result or the test needs to be re-tested, per the business rule protocols. The event symbol begins and ends the decision event. One of two paths are taken, depending upon whether a re-test is needed, or whether the test needs to be verified. The results are transferred automatically form the Medical

Information system to the ED Bed Board system. The lab stores the samples in the machine for the day. The next day, the lab stores the samples in the walk-in refrigerator. The samples are

discarded after seven days. The end oval shows the end of the process map.

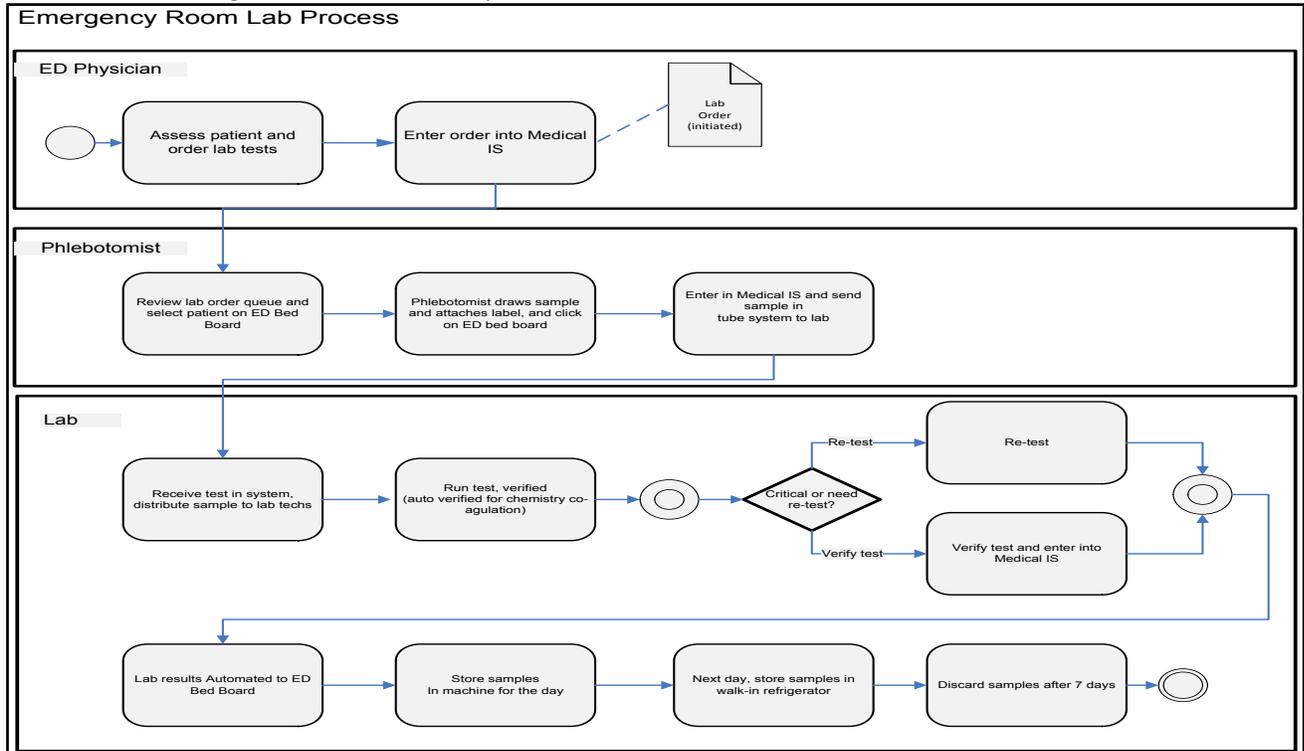


Figure 2 Sample BPMN Business Process Diagram

3.3 Event Process Chain

The Event Process Chain (EPC) diagram has an entirely different look and feel from a process map with swimlanes and a BPMN Business Process Diagram. The EPC method was developed by August-Wilhelm Scheer in the early 1990s. It was developed as part of the Architecture of Integrated Information Systems (ARIS) and is a proprietary methodology embedded within the ARIS SoftwareAG enterprise architecture / Business Process Management software tool (<http://en.wikipedia.org>, 2013). The EPC diagram is typically presented vertically down a page. Events start and end the process diagram, instead of oval start and end symbols in the process maps and BPMN Business Process Diagram. The process steps are called functions, and events either trigger or result from a function. The flow is normally, event-function-event. EPC uses logical operators, or rules. The rules objects are And, Or, and Exclusive OR

(<http://www.ariscommunity.com/event-driven-process-chain>, 2014). Swimlanes can be used within an EPC, but the diagram can get very busy and visually crowded due to incorporating an event between each set of functions. This can cause the EPC diagram to take up at least double the “real estate” compared to a process map. The EPC diagrams do not easily cross pages, due to the lack of an off-page connector symbol, which can cause problems when viewing and printing the EPC diagrams. The common Event-Process-Chain symbols are shown in table 3. The ED Lab process EPC diagram is shown in Figure 3. Notice that there are a lot more symbols used, because each event is separated from the process step, and the gateways are used to identify sequencing and branching.

| Symbol | Name | Meaning |
|--------|------------------------|--|
| | Function (Activity) | An action that performs work |
| | Event | A signal that something happened, which changes the state of a process |
| | Gateway | XOR, OR, AND: Branches, decision, split, merge, or join that controls the flow of activity |
| | Organization | The department or organization that performs the function |
| | Information / Material | Information or material used in the process |
| | Information System | Information System that supports the function |

Table 3 Event-Process-Chain Common Symbols

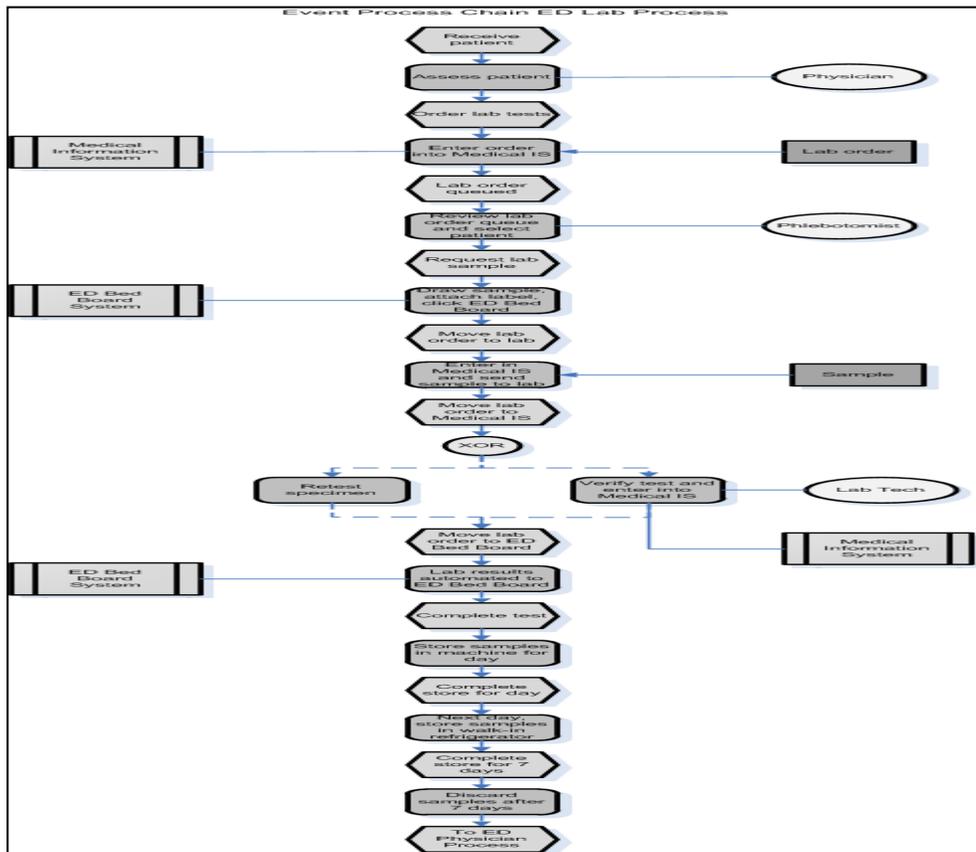


Figure 3 Sample Event Process Chain

3.4 Value Stream Mapping

Value Stream Mapping is a technique used in Lean Manufacturing that has crossed-over to service industries as well. It is a powerful, yet simple tool that can be used to capture the flow of materials or information from a macro or high level perspective. A Value Stream Map (VSM) can highlight: poor information flow; a common understanding of the big picture; the true current state; identify cycle time and process throughput; waste and wasteful activities (non-value added activities); identify major bottlenecks and system constraints. A VSM also helps to focus on differentiating between activities that provide value to the customer, something that they would be willing to pay for, versus non-value added activities, or those that require rework, have defects, or are unnecessary or unneeded. The VSM uses a very simple set of symbols, and can

incorporate diagramming symbols from other notations or tools. The common VSM symbols are shown in Table 1. A sample VSM is shown in Figure 4 for the future state of a new Women’s Healthcare Center. The patient calls the center to set up an appointment for women’s services. The screening appointment is scheduled in the Medical Information System. The patient’s screening appointment is authorized with the insurance company. There is a short delay once the patient arrives at the Women’s Center before the screening is performed. There is an approximate day delay in the patient receiving the results of the screening exam, before the results are read and provided to the patient. The total lead time is 3.3 days, and the value-added processing time is 50 minutes.

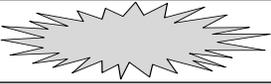
| Symbol | Name | Meaning |
|---|------------------------|--|
|  | Process | An action that performs work |
|  | Inventory | A delay, wait or storage of information or material |
|  | Customer / Supplier | A customer or supplier that performs work in the system |
|  | A push arrow | Represents movement “pushing” material or information through the system based on a plan |
|  | Manual Information | Information flowing manually through the system |
|  | Electronic information | Information flowing automatically (automated) through the system |
|  | Signal Kanban | A signal that the prior process needs to perform work to send material or information to the next process step / workstation |
|  | Kaizen burst` | Designates an opportunity for improvement |
|  | Timeline segment | Represents the time it takes to complete a non-value added activity, and a value added activity |
|  | Timeline total | Designates the lead time (total time) and the value-added processing time through the system |

Table 4 Value Stream Map Common Symbols

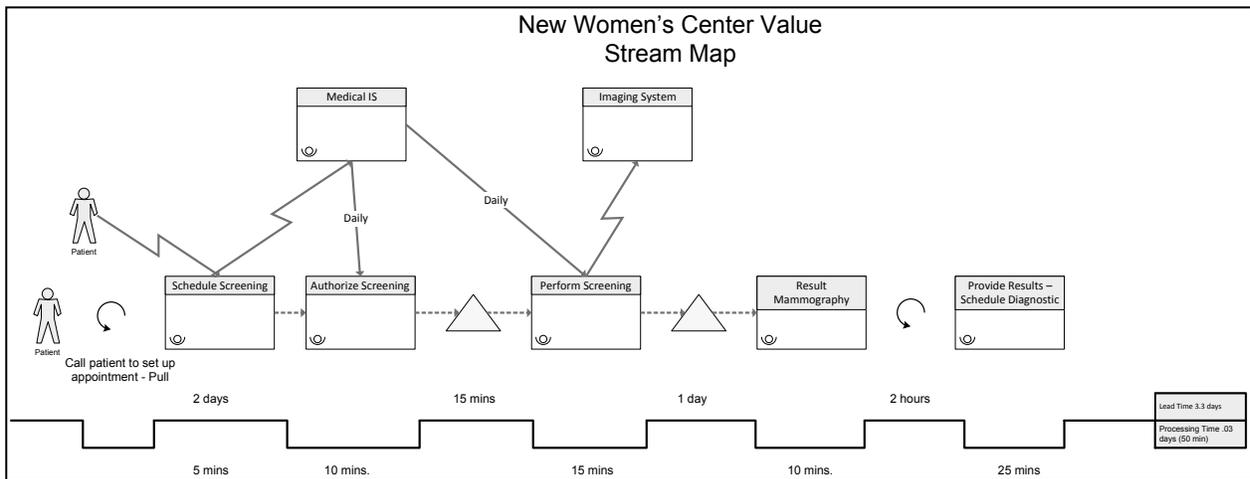


Figure 4 Sample Value Stream Map

4. Advantages and disadvantages of Business Process Modeling tools

Now that we've discussed each of the four business process modeling tools, we can discuss the advantages and disadvantages of each, presented in Table 5 (www.abmp.org). As a general summary, the process maps with swimlanes is probably the easiest and most common tool used of the four tools discussed, but lacks some robustness in capturing complex processes. The BPMN is similar to the process maps with swimlanes, but adds notational rigor to better accommodate migration to a Business Process Management System for automating processes and workflow. The EPC tool represents a

proprietary tool used in the ARIS business process management software tool, and is more complex to learn and use. It also has some major drawbacks in the amount of real estate that it takes to display the diagrams, and in the lack of an off-page connector to easily identify sequence and flow between multiple pages of an EPC diagram. Each organization should determine the objectives of their Business Process Management initiatives and their need for rigor and usability, to determine the best tool for process modeling in their organization.

| Process Modeling Type | Advantages | Disadvantages |
|-----------------------------|--|---|
| Process Maps with Swimlanes | <ul style="list-style-type: none"> Well understood by software engineers and systems engineers At high levels, helps build consensus Adequate for "happy path" illustrations Inexpensive to use Supported by lower-order tools including general-purpose graphics and visualization tools | <ul style="list-style-type: none"> There are many variations of process mapping Not generally considered robust enough for complex process capture Models constructed are "flat", requiring the use of connector symbols to show where process segments continue |
| BPMN | <ul style="list-style-type: none"> Widespread use and understanding, considered by many to be the de facto standard in the U.S. Significant use in the U.S. Department of Defense and other government entities One of the most powerful and versatile | <ul style="list-style-type: none"> Requires training and experience to use full set of symbols correctly Difficult to see relationships among multiple levels of a process Different modeling tools may support different sub-sets of the |

| | notations for identifying process constraints | notation |
|------------------|--|---|
| EPC | <ul style="list-style-type: none"> ▪ Widely used and understood in Germany and other European countries, especially in multinational enterprises ▪ Substantial presence in the U.S. Department of Defense and other large enterprises ▪ May be used as a means of collaboration among groups of functional experts who have little experience with models ▪ One of the most powerful and versatile for identification of process constraints | <ul style="list-style-type: none"> ▪ Less prevalent than BPMN and Process Mapping in U.S. modeling projects ▪ Modeling teams must be disciplined in the use of the notation to avoid possible logic gaps ▪ Strongest implementation is limited to the ARIS family of process modeling tools ▪ Can be visually over-crowded, require additional real-estate compared to other modeling tools ▪ Doesn't have a symbol for cross-page connectors, resulting in difficulty viewing and printing models |
| Value Stream Map | <ul style="list-style-type: none"> ▪ Simple, easy to use ▪ Provides connectivity of cross-functional processes across departments ▪ Provides view of cycle times ▪ Provides insight into value-added and non-value-added process steps and times ▪ Provides information flow ▪ Provides view of customers and suppliers, and supply chain, when appropriate | <ul style="list-style-type: none"> ▪ Flat models ▪ Typically no repository exists |

Table 5 Advantages and Disadvantages of the Four Process Modeling Tools

References

Chang, James, Business Process Management Systems Strategy and Implementation, Auerbach Publications, Boca Raton, FL, 2006.

Graham, L., Business Process Management, Process Modeling and Analysis Workshop Using BPMN, Association of Business Process Management Association, www.bpmn.org, 2013.

Furterer, Sandra L., Lean Six Sigma Case Studies in the Healthcare Enterprise, Springer, New York, New York, 2014.

http://en.wikipedia.org/wiki/Event-driven_process_chain, 2014

<http://www.ariscommunity.com/event-driven-process-chain> , 2014

International Association of Business Process Management Professionals, BPM CBOK, Version 3.0, 1st Edition, www.abpm.org, 2014

Owen, M. and Raj, J., **BPMN and Business Process Management Introduction to the New Business Process Modeling Standard**, Popkin Software, (www.popkin.com), 2003

Rumbaugh, James, Blaha, Michael, Premerlani, William, Eddy, Frederick, Lorensen, William, Object-Oriented Modeling and Design, Prentice Hall, Englewood Cliffs, New Jersey, 1991.

Development of a CAD model of the Hand Using Table-top Scanner

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Abstract

A NextEngine scanner was used in developing a CAD model of a hand. The paper outlines the scanning methodology followed, the development of a fixture for the scanner and hand, and how the process can be used in scanning the stump of transfemoral amputees in efforts to digitize the anatomy.

Introduction

A three-dimensional table-top NextEngine scanner was used in developing a point cloud scan of a hand. Several scans were performed from different angles. This required moving or rotating the hand in relation to the scanner. To help associate the scans with each other, markers were placed on the hand. These markers were visible in the computer program associated with the scanner and placed on top of each other in the software to form a three-dimensional image. Because each scan takes several minutes, it is difficult to hold the hand still for this amount of time. As well, it is difficult to regaining the same position of the hand after moving the scanner to a different angle. To reduce noise due to hand movement a fixture was designed and manufactured onto which the hand was secured. The resulting scans were matched with each other and manipulated using reverse engineering software resulting in a computer-aided design (CAD) model of the hand. The scanning process presented herein was developed to better understand how three-dimensional anatomy models can easily be generated at low cost. In

particular, it is hoped that this process can be used in scanning the limbs of transfemoral amputee patients. These scans can then be used in creating computer-aided design and finite element models of the limbs and prosthesis to better understand the pressure distribution at the interface.

Methodology overview

The process of developing a three-dimensional solid computer-aided model of the hand consisted of first developing a mold of the hand, then using that mold in creating a casting of the hand. The casting was scanned using a NextEngine scanner. The scanned data was first manipulated using the software associated with the scanner and then further manipulated using Geomagics, a specialized reverse engineering software. The output from Geomagics is then importable into NX, a computer-aided engineering software including both CAD and FEM modules.

Mold development

A mold of the hand was developed so that a casting of the hand could be created. It was decided that a casting should be developed for

scanning purposes, rather than scanning the hand of the subject, so as to reduce the discomfort of the subject and the need for the subject to hold the hand still for extended periods of time. It should be noted that while a hand can perhaps be scanned relatively easy without the need of a casting, the process described in this paper was developed to be used for transfemoral amputees who may have a difficult time holding their limb still for an extended period of time.

The subject's hand was first prepared with petroleum jelly and then wrapped with non-toxic plaster wrap, activated with warm water. The plaster wrap was left to set for approximately thirty minutes before removing the hand. The mold was slightly cut at the sides so the hand could be removed.

Figure 1 shows the hand being wrapped with plaster and Figure 2 shows the final mold.



Figure 1: Development of mold



Figure 2: Final mold

Casting process

The mold was prepared by spraying a silicone lubricant inside of it to later aid removal of the mold from the casting. The casting was made of clear polyester casting resin by thoroughly mixing the resin together with its catalyst and then pouring the resin into the mold. The casting was placed outdoors in a ventilated area to allow the casting to fully cure. The mold was then peeled and cut off from the casting. The final casting is shown in Figure 3, and included details such as fingernails and knuckle creases.



Figure 3: Final casting

Fixture design

Before scanning the casting, a fixture was developed so that the casting could easily be scanned from a variety of angles. The fixture allows the casting to rotate 360 degrees at 45 degree intervals and also to have its center axes in two different directions, 45 degrees relative to each other. This allows the casting to easily be scanned from the top and all sides. The fixture design is shown in Figure 4 below. This fixture was designed and manufactured to allow for a variety of castings to be attached, including both hands and residual limbs.

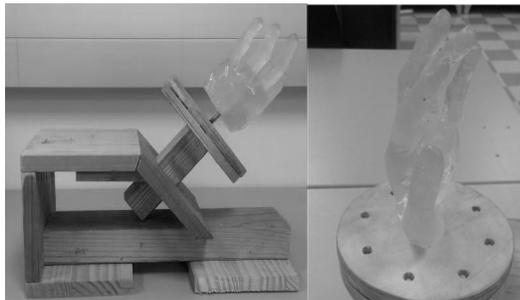


Figure 4: Fixture design

Scanning process and data smoothing

The casting was painted with a non-reflective gray spray paint so that it could more easily be scanned. The casting was attached to the fixture and placed 10 inches in front of the scanners view, as seen in Figure 5. Each scan took approximately 3 minutes to complete, resulting in images similar to what's shown in

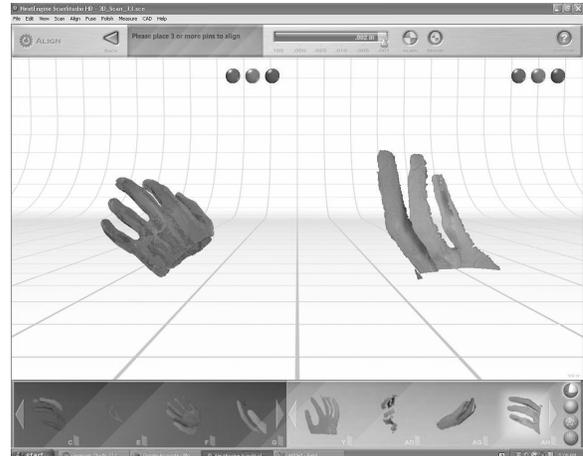


Figure 6. To generate three-dimensional pointclouds from these images, markers were selected in the views and correlated. In

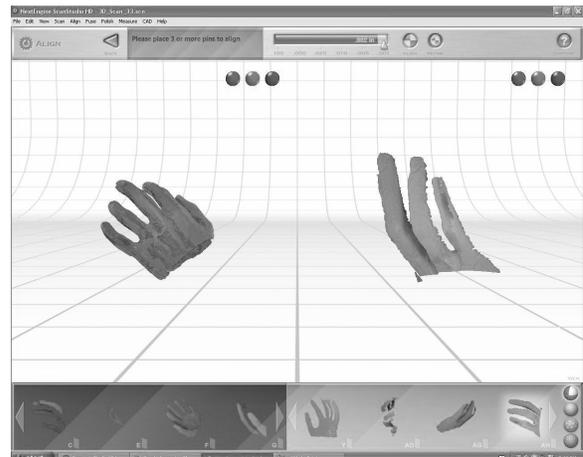


Figure 6 three of these markers are visible from two different scans.



Figure 5: Painted hand in front of scanner.

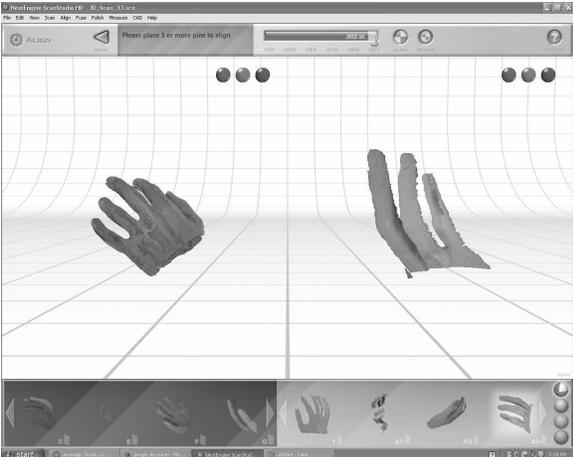


Figure 6: Process of matching scanned data.

Upon combining all of the scans, a point cloud of the complete hand was generated, as seen in Figure 7.

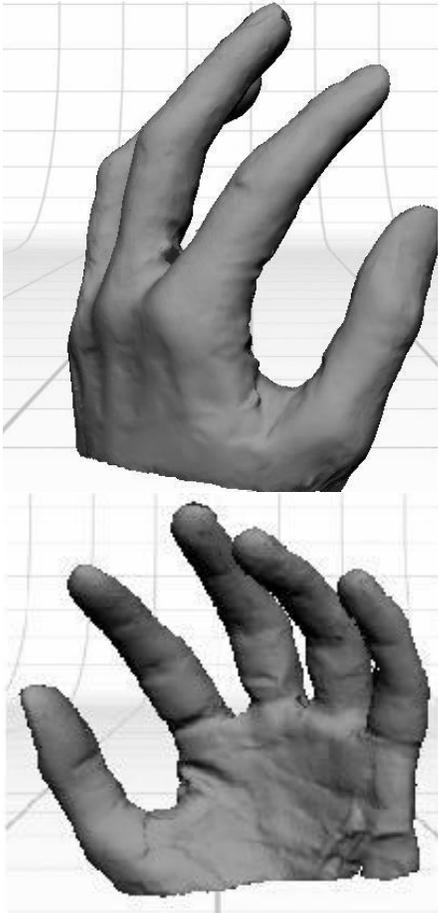


Figure 7: Three-dimensional point cloud of hand

The model shown in Figure 7 was further manipulated to be used in a computer-aided design and finite element environment. The scans were fused together to reduce the amount of holes and discrepancies in the data before exporting the data into a specialized reverse engineering software. Geomagic was used for data smoothing and development of non-uniform rationale B-spline (NURBS) surfaces, as seen in Figure 8. The NURBS geometry can then be imported as three-dimensional solid CAD models by most CAD packages.



Figure 8: Development of NURBS model

Summary

This paper has discussed how a mold of a hand was created and used in making a casting of the same. This hand was then digitized using a NextEngine scanner.

The methodology presented herein was developed to refine a process that can be used in digitizing amputated limbs. Digitizing the limbs will allow for the development of simulation models of the limb-prosthetic interface, in hopes that more comfortable prosthetics can be developed. This work will lay the foundation for applying for an Internal Review Board (IRB) proposal which will present the process of how to digitize the anatomy of transfemoral amputees using inexpensive equipment.

Acknowledgements

Polyhistor International Inc. made this project possible by lending the NextEngine scanner to the researchers.

Enhancing Teamwork and Team Performance: Considering Cognitive Characteristics of Team Development

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Abstract

Teamwork is prevalent across engineering organizations and yet information about how teams operate is still needed. Lean manufacturing facilitators teach lean principles to organizational teams to impact organizational performance; however, there are also psychological attributes that affect the performance of a team. Members within a team have cognitions that play a role in the group's coordination in completing a task. These cognitions include transactive memory, which is developed over time as group members communicate and learn each other's abilities. Another cognitive attribute is mental models, which are internal representations of the tasks and the team processes necessary for team success. Research indicates that mental models created by teams are necessary to quickly and efficiently reach the goals of the team. The purpose of the current article is to describe how these cognitions can affect team performance. With a better understanding of how cognitive aspects of team members impact team performance, lean facilitators will be better equipped to train lean professionals to improve organization performance.

1. Introduction

Lean facilitators train teams on lean principles in hopes that the teams will translate their new skills into improved organizational performance. Normally, performance is measured in terms of the number of parts produced, work-in-progress, lead time, and/or equipment utilization. These improvements are gained through the team's implementation of value stream mapping or the use of other lean tools. It may be the facilitator's perception that the improvements gained by the team is subject

only to the team's ability to learn the technical tools that are taught during the training phase. Literature has shown that team cognitions affect team performance. The goal of this article is to share research on team cognition that impacts teamwork and team performance. This knowledge should be of interest to both academics working with student and research teams, as well as to professional teams and their managers.

Members within a team have attributes that play a role in the group's coordination in

fulfilling a task. Of these attributes, transactive memory, a cognitive property, is developed over time as group members communicate and learn each member's abilities and expertise (Lewis, Lange, & Gillis, 2005). In addition, mental models represent the constituents of taskwork and team processes (Ellis, 2006). Research suggests that mental models that are created by teams (shared mental models) are necessary to quickly and efficiently reach the goals of the team (Resick, Dickson, Mitchelson, Allison, & Clark, 2010). How transactive memory and mental models shared by team members can benefit teamwork and task performance will be addressed in this article.

2. Literature Review

Some tasks may be easily undertaken by a single individual, but many tasks may be too complex or require too diverse a knowledge base for an individual to perform the tasks alone (Cannon-Bowers & Salas, 2001). Numerous businesses and industries are often faced with tasks of this nature, and it is becoming very common for them to incorporate the use of teams to accomplish their goals. In fact, many organizations choose to use teams as the basic structural unit (Wheelan, 1994). Task-focused teams are used more frequently to transact business as organizations become leaner (Kayser, 1990). Due to the increased use of teams in organizations, there is increased need to expose students to good team building processes through education and practice (Buckenmyer, 2000). However, teams often fail to deliver the intended benefit due to poor collaboration, unclear expectations, or poor working approaches (e.g., inadequate or inappropriate structure or schedule). An industry study on training found that between 2000 and 2005, over \$50 billion was spent each year on training

(*Training*, 2005). It was also reported that 64% of organizations provided training on team building.

Collective cognitive aspects of teams have been shown to impact team performance and teamwork processes (for a review, see the meta-analysis by DeChurch & Mesmer-Magnus, 2010). The relation between these team cognitions and team effectiveness has been substantially documented. Two such collective cognitive aspects of teams are mental models and transactive memory.

Transactive memory

Transactive memory involves the individual learning of who knows what in a task; a transactive memory system exists when a group of individuals learns "who knows what" in a task. There are three subcomponents (Specialization, Credibility, and Coordination) involved in the development of transactive memory (Lewis, 2004). Additionally, as a transactive memory system develops there could be an improvement in team performance, produced by the team's communication and the knowledge of each members' ability to perform a task (Austin, 2003; Lewis, 2004). Therefore, at the beginning of a new task, members within a group should initially communicate their expertise and the team should learn the abilities of each member.

A field study showed that familiarity between members and types of communications play a role in transactive memory system development (Lewis, 2004). Once a transactive memory system was established, communication by means other than face-to-face (e.g., email, telephone) lowered team performance. Additionally, Yoo and Kanawattanachai (2001) found that as teams developed transactive memory systems and a collective mind (i.e., social cognitive

systems of individuals sharing their actions), electronic communication decreased. The development of transactive memory may therefore reduce the need for communication without reducing the performance of the team.

The stress of team members can have a strong negative impact the development of transactive memory (Ellis, 2006) and result in poorer group performance. Therefore in the introductory phase of a task, acute stress and the lack of face-to-face communication can decrease the development of transactive memory in teams.

Transactive memory systems have been conceptualized as learning systems that can affect learning transfer and group learning (Lewis, Lange, & Gillis, 2005). Teams with experience and prior transactive memory systems for two similar tasks developed an understanding of the concepts related to their performance on the two tasks. A third, similar task benefited in performance due to the prior transactive memory. Therefore, over time teams may develop transactive memory such that performance is benefited for current and future tasks.

In summary, transactive memory is an attribute that plays a role in a team's coordination in fulfilling a task. The development of transactive memory has been found to be related to team performance (Austin, 2003; Lewis, 2004); and the improvement in team performance is influenced by a team's communication and knowledge of each member's expertise (Lewis, 2004). Additionally, previous experience and prior transactive memory has been shown to affect team performance (Lewis et al., 2005).

Mental Models

According to Mathieu, Heffner, Goodwin, Salas, and Cannon-Bowers, (2000) there are

four types of mental models that can be shared within a team. They are technology/equipment mental models, job/task mental models, team interaction mental models, and team mental models. The technology/equipment mental model refers to how the team members interact with their surroundings and the tools they use to complete the task. Second, the job/task mental model is based on the tasks the team needs to complete. Additionally, there is team interaction mental model; team members use the information about communication and team norms. Finally, the team mental model develops as team members learn the skills and abilities of each team member (Edwards, Day, Arthur, & Bell, 2006; Mathieu et al., 2000). Note that the team mental model, in this conceptualization, is similar to the concept of transactive memory.

With respect to the interaction mental model, three team processes have been classified (Zhou & Wang, 2010). The first is a transition process which focuses on the environment, feedback, and future planning. The second is that of action process which is focused on the execution of the task. Finally, the interpersonal process is related to the interaction of the team members. These processes are important to take into consideration when studying team mental models because the processes can be affected by shared tasks.

Resick and colleagues (2010) also suggest that the two most important mental models include the task mental model and the team interaction mental model, with the task mental models being the most influential for a successful team.

Zhou and Wang (2010) suggest that there is a positive impact of shared mental models and team processes on a team's performance.

The more similar the teams members' mental models the better performance outcome should be.

In the studies of mental models in teams, most psychological research has been done on *ad hoc* teams, where people are placed together to work on a specific project and are usually together for only that project and then disband. This type of team would be similar to an IPT. The other type of team studied is that of an already established team, one that is already in existence, such as a basketball team. It is important to differentiate which type of team is being studied when focusing on mental models because teams generally take time to develop mental models that are similar to each other, which allows them to efficiently complete their tasks (Resick et al., 2010).

As for transactive memory, stress due to job demands can negatively affect how mental models among the team develop over time (Ellis & Pearson, 2011). However, cross-training the team members allow for a reduction in stress and thus improve the performance of teams (Ellis & Pearson, 2011). More than likely, this is because the team members create a mental model that indicates how the team members and their respective jobs fit together (Ellis, 2006). In order for cross-training to happen, communication is important (Kennedy & McComb, 2010). Cross-training the members of teams has been shown to assist in the creation of shared mental models (Marks, Sabella, Burke, & Zaccaro, 2002).

In summary, shared mental models in teams change over the time, as the team members are working together on their assigned task. Shared mental models among the team members generally results in better performance for the team (Edwards et al., 2006).

3. Discussion

The influences of transactive memory have been found to have a significant positive influence on group performance (Austin, 2003). Transactive memory involves a team member learning "who knows what" in fulfilling a task. However, in order for a team to have an increase in performance, knowledge of each member's ability must be communicated within the team (Lewis, 2004). Furthermore, the type of communication that takes place can affect the development of transactive memory and the group's performance (Lewis, 2004).

References

- Austin, J. R. (2003). Transactive memory in organizational groups: The effects of content, consensus, specialization, and accuracy on group performance. *Journal of Applied Psychology, 5*, 866-878. doi:10.1037/0021-9010.88.5.866
- Edwards, B. D., Day, E., Arthur, W. R., & Bell, S. T. (2006). Relationships among team ability composition, team mental models, and team performance. *Journal of Applied Psychology, 91*(3), 727-736. doi:10.1037/0021-9010.91.3.727
- Ellis, A. P. J. (2006). System breakdown: The role of mental models and transactive memory in the relationship between acute stress and team performance. *Academy of Management Journal, 49*, 576-589.
- Ellis, A. J., & Pearsall, M. J. (2011). Reducing the negative effects of stress in teams through cross-training: A job demands-resources model. *Group Dynamics: Theory, Research, and Practice, 15*(1), 16-31 doi:10.1037/a0021070

Lewis, K. (2004). Knowledge and performance in knowledge-worker teams: A longitudinal study of transactive memory systems. *Management Science*, *50*, 1519-1533. doi:10.1287/mnsc.1040.0257

Lewis, K., Lange, D., & Gillis, L. (2005). Transactive memory systems, learning, and learning transfer. *Organization Science*, *16*, 581-598. doi:10.1287/orsc.1050.0143

Marks, M. A., Sabella, M. J., Burke, C., & Zaccaro, S. J. (2002). The impact of cross-training on team effectiveness. *Journal of Applied Psychology*, *87*(1), 3-13. doi:10.1037/0021-9010.87.1.3

Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. (2000). The influence of shared mental models on team process and performance. *Journal of Applied Psychology*, *85*(2), 273-283. doi:10.1037/0021-9010.85.2.273

Resick, C. J., Dickson, M. W., Mitchelson, J. K., Allison, L. K., & Clark, M. A. (2010). Team composition, cognition, and effectiveness: Examining mental model similarity and accuracy. *Group Dynamics: Theory, Research, and Practice*, *14*(2), 174-191. doi:10.1037/a0018444

Yoo, Y., & Kanawattanachai, P. (2001). Developments of transactive memory systems and collective mind in virtual teams. *The International Journal of Organizational Analysis*, *9*, 187-208. doi:10.1108/eb028933

Zhou, Y., & Wang, E. (2010). Shared mental models as moderators of team process-performance relationships. *Social Behavior and Personality*, *38*(4), 433-444. doi:10.2224/sbp.2010.38.4.433

Using Wearable Technology to Break Down Communication Barriers

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Abstract

In this global society, we are becoming more inter-connected every day. The increased inter-connectivity opens up new possibilities, such as global leaders working together to obtain peace or expert scientists coming together to work on cutting edge research. One of the main challenges is a language barrier, which is often solved by having translators, which can be costly and not practical. Another solution is for the person to learn another language, which is difficult and can take years to master. There needs to be a quick, cheap, and readily accessible way of translating languages. With the rise of wearable technology, ways of communicating have opened up such that they can be used while still being involved in the world around them. We designed WIT (Wearable Integrated Translator), an integrated system for Google Glass that connects multiple users together. The system listens to the user and then translates what the user is saying to another language that the users speak. Using WIT allows for groups of audiences who could speak several different languages to communicate simultaneously without the need for translators or using polyglotism. Having the ability to simultaneously speak to an audience who uses several different languages lets us break down communication barriers.

1. Introduction

Before the Internet, communication between different countries was challenging. Often, it involved a messenger delivered through a month long excursion. If you needed to travel across an ocean, you would have needed several months, assuming that the messenger has survived the trip there. Today, we live in a society where we deal with other countries on a day-to-day basis instantaneously. With this rapid communication ability now readily available, several doors were opened for communication: trading amongst different countries, sharing knowledge and information, and the union of countries to strive for a peace in a world full of conflict.

Now as a fully integrated society, the need to communicate with people who speak different languages is still a problem that has yet to be addressed. There are a few solutions that exist to this ever-growing issue, but each with its own drawbacks.

1.1 Learning a New Language

One way for people who speak different languages to communicate is for them one of them to learn a new language. Learning a new language is the best way to be able to communicate with someone. However, learning a new language is very difficult in less than an early age (Asher, The Optimal Age to Learn a Foreign Language). It could take years

for someone to be able fluently speak a language. With programs such as Rosetta Stone, which assist in making you fluent, claim that it would take 2,500 hours of training to be able to learn to speak Spanish if they take all of the courses they offer. In addition to the massive time commitment, there are also high costs associated. For Rosetta Stone, they charge a five-hundred dollar fee for the course material. In addition, there are many aspects of speaking languages that Rosetta Stone does not do well (Nagle, 2013).

1.3 Translators

Translators are the standard for communication between groups of audiences who speak different languages. Any political event where communication is needed between people who speak different languages you will see translators (Cao, Translation at the United Nations as Specialized Translation). Translators however, require a lot of time to use their services. As a customer, you must first identify the languages of the audience speak you want to communicate with. You have to organize and plan a time for everyone that you want to communicate with to attend. This requires a lot of time and planning. The ability to have a spontaneous conversation with people is not possible.

In addition, the costs are extremely high. You would have to hire a translator for every language that was represented in the conversation. Translators charge a steep rate of around 16 cents per word (McKay, 2013). As you could imagine the costs involved can escalate quickly. As an example, the cost for a translator to read my paper up to when I told you the rate would cost two hundred sixteen dollars and ninety-six cents if I wanted it translated in Spanish and French. While these costs might not be much to politicians or businesses, for the average person, it is not feasible to pay this much.

1.4 Online Translations

After discussion with several people who came to the United States, not fluently speaking English, I discovered that many of them relied on translation services such as Google Translate. They would enter in the text they were trying to say in their language and the service would translate what they were trying to say in English text where they then could show the person what they were trying to say. In comparison to the above methods, this is the most cost-effective and time-efficient. These translation services are free and just requires you to be on their website in order to get your translation. However, this breaks the smooth flow of conversation. It requires everyone to be sitting in front of laptops. In addition, it is not integrated with our daily lives, so spontaneous conversation is still limited.

1.5 Contributions

By using wearable technology as a translation service, this eliminates the need to learn a new language, eliminates the need for an expensive translator, and is integrated into your daily life while giving you the ability to have a full conversation. With these issues now circumvented, the ability to easily communicate with people who speak different languages now becomes a real possibility for people who cannot always anticipate the need of a translator or who cannot afford one.

2. Translations Using Wearable Technology

With the rise of wearable computing, there are now many new ways that we interact with technology in our daily life. Where we used to be confined to rooms that our computers were in, now we can travel almost anywhere and still be able to connect online or compute. For the case of translations, many of the previously spelled out issues can be addressed. For this implementation, Google Glass was used for translations. Google Glass is a wearable computer that mimics a pair of

glasses. On Glass, included in a screen consisting of a class block where a projection is displayed. It has voice recognition and commands, as well as a bone conductor that allows you to hear output.

2.1 Integration

With the introduction of wearable computing, now more than ever has computing becoming an integrated part of our life. With Google Glass, it becomes apart of you. Anytime you need Glass, you simply tap the side of it and you have access to its computing power. While it can be argued a phone is just as integrated, with a phone you have to pull it out of your pocket, unlock it, and launch the application you are trying to use. Due to the amount of steps required, communication is not as natural and flowing. In addition, using a phone as a translation services takes you out of the conversation. So much of a conversation is body language. If you stare at a phone for a translation service, you lose that aspect of communication. With Glass, the transparent prism allows you to use a translating service, hands free, while still keeping that important aspect of communication.

2.2 Cost-Effective

If you want to be able to translate between different languages without breaking your conversation, there will be some high expenses involved. Using wearable technology's ability to access the web, it can utilize free translations such as Google Translate in order to translate from one language to another.

3. Technical Implementation

In this section, I will go into detail on how I implemented a translation service, WIT, as a Glass application. First I will go into detail on the initialization of creating a communication room of the audience you wish

to speak with. Then I will discuss the structure of conversation using WIT and how the message is translated and sent back.

First, a user must create an account on a hosted website in order to use WIT. The web application was created using Java s due to it's ability to be work with Glass's SDK. c. The website has a form where users will enter in their name, email address, and the language they speak. Once submitted, their information is stored in a PostgreSQL database. Once registered, they need to download the through the website.

Now that the WIT application is installed on Google Glass, the application can now be activated through Google Glass by saying the phrase "Ok Glass, start translating..." It will then ask you if you want join a conversation or start one through a series of timeline cards. An example of a timeline card through Glass is shown in Figure 1.



Figure 1: A sample timeline card from Glass

If the user chooses to start a conversation, the WIT application will assign a unique pin to that room that is used to be able to allow other users to join that chat room and then the pin is added to the users database entry as shown in Figure 2. The code for that chat room is then displayed to the creator of the chat room where they could then share that code to who they were wishing to communicate with. Once another user has received the code, the user can then join that room by selecting to join a chat room, and entering in that unique pin. WIT's server will then looking for a matching database entry with that pin and have

them enter the chat room, if it exists. This process can be done until everyone who the user wants to join the chat room is in.

| Name | Email Address | Language | Pin |
|--------|-------------------------|------------|-------|
| Dylan | dylan.watson@test.com | English | 64321 |
| Paulus | paulus.wahjudi@test.com | Indonesian | 64321 |
| Keyur | keyur.patel@test.com | Hindi | 64321 |

Figure 2: A sample database entry

Now that the chat environment has been established, it is time to handle the translation and communication process. In order to signal for Google Glass to listen to the user for translating, the user will hold their finger on the touch pad on the side of Glass while they are talking. After they have finished their thought, the user will remove their finger from the sensor. Upon release, Google Glass uses its speech recognition software in order to convert the spoken words to text that can be used for processing. Now as text, we can now utilize online translation services.

```
chatRoomUsersQuery = "SELECT Users.name, Users.email,
Users.language WHERE Users.pin= ?";
PreparedStatement pt = connection.prepareStatement(chatRoomUsersQuery);
pt.setString(1, enteredPin);
pt.executeQuery();
if(pt == null)
    return chatRoomNotFoundMessage;
else
    return chatRoomFoundMessage;
```

Figure 3: Code of WIT's chat room structure

The message in text format, along with the user's information is then sent to WIT's server. WIT's server parses through the message, first identifying the chat room they are in and seeing the languages that are being spoken. Next WIT's server looks at the person who sent the message and the language they speak. Now utilizing Google's Translate API, a HTTP request is made using the following parameters: the message to be translated, the source language, and the language it is being translated to. This is done for each language that is in the chat room.

```
while(listening)
{
    String translatedText = Translate.DEFAULT.execute(message, sourceLanguage, destinationLanguage);
    TimelineItem timelineItem = new TimelineItem();
    timelineItem.setText(translatedText);
    service.timeline().insert(timelineItem).execute();
}
```

Figure 4: Code for WIT translating text

Google's Translate API now returns a JavaScript Object Notation (JSON) object containing the translated text. This object is parsed until the newly translated text is stored. Now, this text is sent to the other users in the chat room who speak the appropriate language.

```
1 200 OK
2
3 {
4   "data": {
5     "translations": [
6       {
7         "translatedText": "Hallo Welt"
8       }
9     ]
10  }
11 }
```

Figure 5: JSON Object from Google Translate

This translated message comes in the form of a timeline card where the user will be able to see who sent the message along with the message they just sent. From here, they could also have the option of having the message read out loud to them, playing through the bone conductor on Google Glass or the earbud connected to it. Now that the message has gone through, other users who are in the chat room can then respond to the message, following the same process.

As part of Google Glass's system design, Google handles the synchronization between applications and user's Glass. This removes the burden from developers of needing to ensure content is delivered.

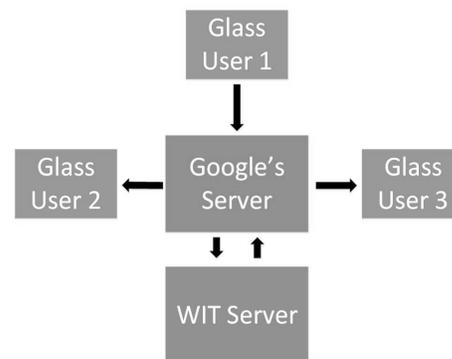


Figure 6: System Design of WIT

3.1 Issues with Implementation

As many people have observed, often when a language is translated to another, there are some errors in the meaning or words. Google's Translate API is guilty of this as well. Because of this error in translation, this could cause confusion of the message intended for the conversation. However, Google Translate includes a Translation Toolkit that allows users to give feedback for incorrect translations. They could mark that the translation is incorrect and then give what it should have translated too. This gives Google's Translate service the ability to improve with the more use of the product.

In addition, there is also a delay caused by the translation and the Google Glass timeline card synchronization. This causes conversation to not be in real-time. Typically, the delay for a message to be received after it has been sent in by someone else is 5 seconds.

4. Related Work

Currently, there is already a Google Glass application called Word Lens. Word Lens allows you to take an image of text and translate it (Rosenbloom, 2014). While this approach is good in the event that you might be in a different country, trying to understand different signs, it does not support voice conversations between people. One great thing about Word Lens though is that it works even with no Internet activity. This means that they are able to read text from an image and then translate it without the need of some third-party translation service. If this was implemented for WIT, there would not be a need to make an online request, improving the overall quality of the application because it does not rely on Internet and it would increase the speed of how quick the translation could be made since it would not have to make an external call.

Microsoft is currently working on a voice-to-voice translation for their Skype application (Anthony, 2012). When you break

it down, it still goes into a speech-to-text service, but they are able to maintain the accent, timbre, and intonation of your actual voice. The program has you go through a one-hour training period where it creates a model of your voice and listens how you say certain sounds. Once this is done, as it plays your message translated it sounds as if you are the one speaking the message.

5. Conclusion

In conclusion, WIT allows for a better conversation. Thanks to the hands-free and integrated features of Google Glass, communication between people who speak different languages now becomes a more possible solution for the average person. With this affordable and integrated translator, hopefully communication between people who speak different languages can work together and do great things.

5.1 Future Work

For future work, create a built-in translation service into the application to omit the use of a third-party over the web. This would increase the speed performance of WIT, which would lead to a more natural language translation.

Now that this service has been established, it would be interesting to see a survey from people using this translation service to determine if it makes for a better conversation. In this survey, you could also examine how often errors occurred and if it so much so that conversation was difficult.

6. Acknowledgments

I would like to thank the National Aeronautics and Space Administration West Virginia Space Grant Consortium for funding this research.

7. References

Anthony, S. (2012, March 12). Microsoft unveils universal translator that converts your voice into another language | ExtremeTech. *ExtremeTech*. Retrieved July 21, 2014, from <http://www.extremetech.com/extreme/122083-microsoft-unveils-universal-translator-that-converts-your-voice-into-another-language>

Asher, J., & Garcia, R. The Optimal Age to Learn a Foreign Language. *The Modern Language Journal*, 53, 334.

Cao, D., & Zhao, X. Translation at the United Nations as Specialized Translation. *The Journal of Specialised Translation* , 16.

McKay, C. (2013, October 29). What is "the right rate" for your translation services?. *Thoughts On Translation*. Retrieved July 21, 2014, from <http://thoughtsontranslation.com/2013/10/29/what-is-the-right-rate-for-your-translation-services/>

Nagle, D. (2013, May 20). The Most Balanced Rosetta Stone Review You'll Ever Read. *The Mezzofanti Guild RSS*. Retrieved July 21, 2014, from <http://www.mezzoguild.com/rosetta-stone-review/>

Rosenbloom, S. (2014, January 25). Google Tools for Globetrotters. *The New York Times*. Retrieved July 21, 2014, from http://www.nytimes.com/2014/01/26/travel/google-tools-for-globetrotters.html?_r=1

Hostage Rescue Mission – A Multiplayer Gamemode for ArmA3

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Abstract

Video Games continue to evolve and present great entertainment value. This provides a great avenue for game programmers and enthusiasts to venture into even greater domains. In this work, we will develop, describe and present a “Hostage Rescue” mission, which is a multiplayer gamemode for the game ArmA3. ArmA3 is a realistic military simulator with a great modding community and player base. The game features its own scripting language (SQF) and allows the players to build upon the game with their own capabilities being the limit. “Hostage Rescue” is a team versus team versus team gamemode that consists of a SWAT team, a Hostage team, and a Terrorist team. Players join one of the three teams and must fulfill their roles. The SWAT team must rescue the hostages from the terrorists and/or eliminate all members of the terrorist team. The terrorist team must keep the hostages under their control to avoid escapees. The hostages must role-play in order to keep the game interesting; Hostages remain under the control of the terrorists and must wait to be rescued by the SWAT team. The hostages may escape if they have the chance, but risk their lives doing so.

Keywords: gamemode, ArmA3, modding, SQF.

1. Introduction

Real-life simulations of events or training can be costly and even dangerous given certain conditions. A solution to this issue is to migrate to a software-simulator environment. Unlike real-life simulations, a software simulation is cost-effective and harmless, usually requiring a single purchase for the

software as opposed to the traditional costs required to run real simulations. As technology advances, many training exercises (especially military) can be brought into a software-simulated environment where trainees can engage in their usual practice within a fraction of the usual cost. Not only is software-simulation cost-effective but due to the power of current technology, it also allows flexibility; complex calculations can be done in real-time and data can be pulled in from various

sources. This is the essence of our Hostage Rescue Simulation.

2. Hostage rescue Usage

At a military standpoint, the idea of using software-simulations can be life-saving and more effective. Instructors will not need to worry about injuries, and are able to create complex scenarios for troops to run through. As previously stated, data can be pulled in from various sources, for example, if an instructor was required to run troops through a non-fictional environment from somewhere in the world, the geo-data from that area can be loaded into the simulator in order to create a realistic environment, and real-time weather and time data can also be loaded into to replicate the exact conditions of that area. After a scenario has ended, the instructor can review every detail that has occurred throughout the run, pinpointing areas that need improvement. The U.S. Army has licensed the simulator "Virtual Battlespace" [2] to do just that.

3. Hostage rescue capability

Hostage Rescue is a simulator. Although the Hostage Rescue gamemode leans more towards an actual game than a simulation, it is on a simulation platform (ArmA3, Real Virtuality Engine by Bohemia Interactive Studios [1]) that takes in account for weapon ballistics, weather simulation, real time-of-day simulation, and more, while providing a rich non-fictional environment. Hostage Rescue provides players with a gamemode that allows them to team up and eliminate the enemy; but beyond that,

it is also a simulation of an event that is possible to occur. Players have to devise how they are going to execute their mission. They must work together and think of how they are going to "win" the round. The gamemode consists of many randomization elements per each round: weather, time of day, area, angle of attack. This means that no one round would be the same; players will not be able to adapt to the scenarios, which prevents long-time players from knowing the ins and outs of the situation. Hostage Rescue is a project that our team developed to mimick a practical hostage rescue situation.

4. Hostage Rescue algorithms

One of the main features we wanted to have in Hostage Rescue was to have completely randomized round locations to break away from players being used to the same areas and already knowing how to approach their objective. To do so, we are given an already impressively huge map in ArmA3, which we give the players a small portion of per round at a random location. This location needs a building for the terrorist and hostages to be located in. With this in mind, our locations were narrowed down to every single building on the map (which is estimated to be ~21000). Per round, the location is centered around one of these buildings, and many factors of the round are randomized, such as weather, angle of approach, time-of-day, and player loadout. Players are truly uncertain of how

the round will play out, especially with the human factor.

We also wanted to add in flashbang grenades, used to temporarily disorientate players. In order to do so, we needed to determine if the player was able to see the grenade, resulting in them being blinded. Not only does the player have to be facing the grenade, but they must also not have objects blocking their view of it.

```

48 GetAllBuildingsArray =
49 {
50     _buildings = nearestObjects[buildingScanner,["Building"],100000];
51     {
52         _countPos = 0;
53         if(_x distance purgatoryTrigger >= 1500) then
54         {
55             for "_i" from 0 to 50 do
56             {
57                 if(([_x buildingPos _i] select 0 != 0 && ([_x buildingPos _i] select 1 != 0 &&
58                    [_x buildingPos _i] select 2 != 0) then
59                 {
60                     _countPos = _countPos + 1;
61                 };
62             };
63
64             if(_countPos == 0) then
65             {
66                 _buildings = _buildings - [_x];
67             }
68             else
69             {
70                 _x setVariable ["posCount",_countPos,false];
71                 if(debug) then
72                 {
73                     _mName = format["%1",_x];
74                     _dot = createMarkerLocal[_mName,[position _x select 0,position _x select 1]];
75                     _dot setMarkerShapeLocal "ICOM";
76                     _mName setMarkerTypeLocal "mil_dot";
77                     _mName setMarkerColorLocal "ColorRed";
78                 };
79             };
80         } foreach _buildings;
81
82         allBuildings = _buildings;
83
84         _list = "";
85         [if(allBuildings find _x == count allBuildings - 1) then {_list = _list +
86            (format["%1,%2",position _x, _x getVariable "posCount"]);} else {_list = _list +
87            (format["%1,%2",position _x, _x getVariable "posCount"]);}] foreach allBuildings;
88         copyToClipboard _list;
89         titleText["Building array copied to clipboard!\nPaste the array into
90            BuildingPositionArray.dat under Game\Server\ into the 'bList' array", "PLAIN"];
91     };
92 }

```

Figure 1: Algorithm to gather all buildings on the map

```

99 CanSee =
100 {
101     _obj0 = _this select 0;
102     _obj1 = _this select 1;
103     _return = false;
104     _intersect = lineIntersects [eyePos _obj0, aimPos _obj1, _obj0, _obj1];
105
106     if(!_intersect) then
107     {
108         _dirFacing = direction _obj0;
109         _fov = 160;
110
111         _leftAngle = (_dirFacing - (_fov/2));
112         if (_leftAngle < 0) then
113         {
114             _leftAngle = _leftAngle + 360;
115         };
116
117         _rightAngle = (_dirFacing + (_fov/2));
118         if (_rightAngle > 360) then
119         {
120             _rightAngle = _rightAngle - 360;
121         };
122
123         _dirTo = ([_obj0, _obj1] call BIS_fnc_dirTo);
124         if (_dirTo < 0) then
125         {
126             _dirTo = _dirTo + 360;
127         };
128
129         if (_dirTo >= _leftAngle && _dirTo <= _rightAngle) then
130         {
131             _return = true;
132         }
133         else
134         {
135             if (_leftAngle > _rightAngle) then
136             {
137                 if (([_dirTo >= _leftAngle && _dirTo < 360] || [_dirTo <= _rightAngle && _dirTo > 0]) then
138                 {
139                     _return = true;
140                 };
141             }
142             else
143             {
144                 _return = false;
145             };
146         };
147     };
148     _return
149 };
150 }

```

Figure 2: Algorithm written to determine if two objects can see each other

```

1 FlashbangEffect =
2 {
3   _affected = _this select 0;
4   _pos = _this select 1;
5   [_pos] spawn
6   {
7     _pos = _this select 0;
8     _soundSource = (group server) createUnit ["LOGIC",_pos , [], 0, ""];
9     _soundSource setPosATL _pos;
10    _soundSource say3D "flashBang";
11
12    if(player distance _pos <= 5 && !(lineIntersects [eyePos player, aimPos _soundSource,
13    player, _soundSource])) then
14    {
15      player setDamage ((damage player) + (((5 - (player distance _pos))/5)/2));
16    };
17
18    _flash = "#lightpoint" createVehicleLocal _pos;
19    _flash setLightBrightness 0.5;
20    _flash setLightAmbient[1, 1, 1];
21    _flash setLightColor[1, 1, 1];
22    _flash setLightIntensity 1000;
23    _flash setLightDaylight true;
24
25    sleep 0.25;
26    deleteVehicle _flash;
27
28    sleep 4;
29    deleteVehicle _soundSource;
30  };
31
32  if(player in _affected && player distance _pos <= 15) then
33  {
34    titleText ["", "WHIRE OUP", 0.05];
35    playSound "flashBangRing";
36    addcamShake [3, 11, 35];
37    sleep 0.1;
38    player setDir ((direction player) + ([40] call NegRandom));
39    sleep 2.7;
40    titleFadeOut 40;
41  };
42 };

```

Figure 3: Flashbang effect code

```

1 newSound =
2 {
3   if(!debug) then
4   {
5     waitUntil {west countSide playableUnits > 0 && east countSide playableUnits > 0 && civilian countSide
6     playableUnits > 0};
7   };
8
9   // Clean up dead bodies/BSPROF
10  if(!isNil "SWATHel") then {deleteVehicle SWATHel};
11  if(!isNil "newsHel") then {deleteVehicle newsHel};
12  if(!isNil "newsHelPilot") then {deleteVehicle newsHelPilot};
13  {deleteVehicle _x} forEach allDead;
14
15  // Set building
16  _tElement = list call SelectRandom;
17  targetBuilding = nearestBuilding [_tElement select 0];
18  targetPos = position targetBuilding;
19  if(debug) then {copyFileClipboard str(targetPos)};
20  publicVariable "targetPos";
21
22  // Random weather/time
23  setWind ([10] call NegRandom, [10] call NegRandom, true);
24  _windDir = random 360;
25  _windForce = random 5;
26  _rain = random 1;
27  _rainbow = random 1;
28  _overcast = random 1;
29  _fog = [random 0.5, random 0.2, random((targetPos select 2) + 20)];
30  0 setWindDir _windDir;
31  0 setWindForce _windForce;
32  0 setRain _rain;
33  0 setRainbow _rainbow;
34  0 setOvercast _overcast;
35  skipTime round(random 24);
36  _time = date;
37  0 setFog _fog;
38
39  //Set game boundary & blackout
40  gameBoundary setPos targetPos;
41  gameWarningBoundary setPos targetPos;
42  "borderRect" setMarkerPos targetPos;
43  "sizeBorder" getMarkerSize "borderRect";
44  "size" getMarkerSize "blackoutTop";
45  "blackoutTop" setMarkerPos [(targetPos select 0, (targetPos select 1) + (_size select 1) - (_size select 1));
46  "blackoutBottom" setMarkerPos [(targetPos select 0, (targetPos select 1) - (_size select 1) - (_size select 1));
47  "blackoutLeft" setMarkerPos [(targetPos select 0) - (_size select 0), (targetPos select 1);
48  "blackoutRight" setMarkerPos [(targetPos select 0) + (_size select 0), (targetPos select 1);
49
50  // Extract point
51  extractPos = [100,0,targetBuilding] call RandomCircumference;
52  _emptyPos = extractPos findObjPosition [0,20];
53  if(count _emptyPos != 0) then

```

```

53  {
54    extractPos = _emptyPos;
55  };
56
57  extractTrigger setPos extractPos;
58  tBMarker setMarkerPos targetBPos;
59  publicVariable "extractPos";
60  extractSmoke setPos extractPos;
61  smokeWeight setPos extractPos;
62  exMMarker setMarkerPos extractPos;
63
64  //Spawn news chopper
65  if(!isNil "newsHelGroup") then {newsHelGroup = createGroup civilian};
66  heliSpawnPos = [100,60,targetBuilding] call RandomCircumference;
67  newsHel = createVehicle ["B_Heli_Light_01_F", heliSpawnPos, [], 0, "FLY"];
68  newsHel setDir (random 360);
69  newsHel setObjectTextureGlobal [0,"3\air_f\Heli_Light_01\Data\Skins\heli_light_01_ext_wave_co.paa"];
70  "C_man_polo_1_F" createUnit [heliSpawnPos, newsHelGroup, "newsHelPilot = this"];
71  newsHelPilot moveInDriver newsHel;
72  newsHelPilot setBehaviour "SAFE";
73  while {(count (toArray newsHelGroup)) > 0} do
74  {
75    deleteWaypoint ((WAYPOINTA newsHelGroup) select 0);
76  };
77  _wp = newsHelGroup addWaypoint [targetPos, 0];
78  _wp setWaypointBehaviour "SAFE";
79  _wp setWaypointType "LOITER";
80  _wp setWaypointLoiterRadius 60;
81  _wp setWaypointSpeed "LIMITED";
82  newsHel flyInHeight 60;
83  if(surfaceIsWater (position newsHel)) then
84  {
85    newsHel setPosASL heliSpawnPos;
86  }
87  else
88  {
89    newsHel setPosATL heliSpawnPos;
90  };
91
92  // Handle SWAT Team spawn
93  heliSpawnPos = [500,40,targetBuilding] call RandomCircumference;
94  dirTo = [heliSpawnPos,targetBPos] call BIS_Fnc_DirTo;
95  _heliClass = "O_Heli_Light_02_unarmed_F";
96  SWATHel = createVehicle [_heliClass, heliSpawnPos, [], 0, "FLY"];
97  SWATHel setDir dirTo;
98  if(surfaceIsWater (position SWATHel)) then
99  {
100   SWATHel setPosASL heliSpawnPos;
101 }
102 else
103 {
104   SWATHel setPosATL heliSpawnPos;
105 };

```

Figure 4: Server side algorithm

```

106 // Hostage & terrorist spawns
107 BuildingSpwn = targetBuilding buildingPos (floor(random((tElement select 1) - 1)));
108
109 // Move players to spawn
110 bluforTeam = [];
111 if(side _x == west && isPlayer _x) then {bluforTeam = bluforTeam + [_x]}; forEach playableUnits;
112 roundFlt0 = bluforTeam call SelectRandom;
113
114 //Groups SWAT
115 if(!isNil "SWATGrp") then
116 {
117   SWATGrp = createGroup west;
118   bluforTeam joinSilent SWATGrp;
119   //Update round for clients
120   [extractPos,SWATHel,buildingSpwn,roundFlt0,[_windDir,_windForce,_rain,_rainbow,_overcast,_time,_fog],"UpdateRound",
121   true,false] spawn BIS_Fnc_MF;
122   sleep 5;
123   [] spawn MidSound;
124 }
125
126 MidSound =
127 {
128   if(debug) waitUntil {};
129   _run = true;
130   _cond = -1;
131   while !_run do
132   {
133     // Get all players per team in game area
134     _gamePlayers = list gameBoundary;
135     if (!isPlayer _x) then
136     {
137       _gamePlayers = _gamePlayers - [_x];
138     };
139     forEach _gamePlayers;
140     _terrorists = [];
141     _SWAT = [];
142     _survivingHostages = [];
143
144     switch(side _x) do
145     {
146       case west:
147       {
148         _SWAT = _SWAT + [_x];
149       };

```

Figure 5: Randomization algorithm

5. Our Experience

While developing these projects, we have gained knowledge on simulation development, and what elements to focus on. We have also gained confidence to create better applications, using the experience and mistakes made during these projects. Some of our team members have plans to joining the field of game development and/or simulation software. One of our current projects in development is an AI overhaul modification for the game ArmA3, dubbed "Firefight Improvement System 2" [3], continuing off our previous modification [4] that the game's community has seen great use from.

6. Results and future work

As stated previously, one of our current projects in development is an AI overhaul modification for the game ArmA3, dubbed "Firefight Improvement System 2" [3], continuing off our previous modification [4] that the game's community has seen great use from. The Firefight Improvement System 2 will exhibit the key benefits of the current Hostage Rescue simulation with the added advantages of a better AI.

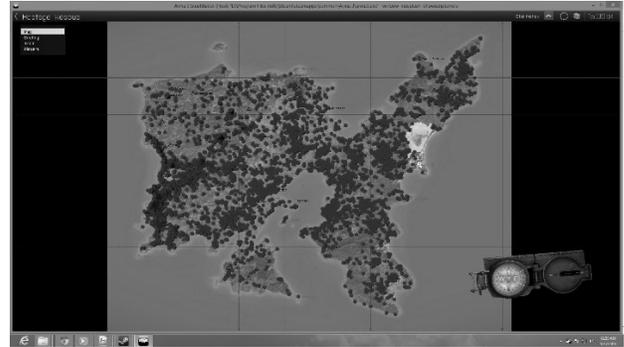
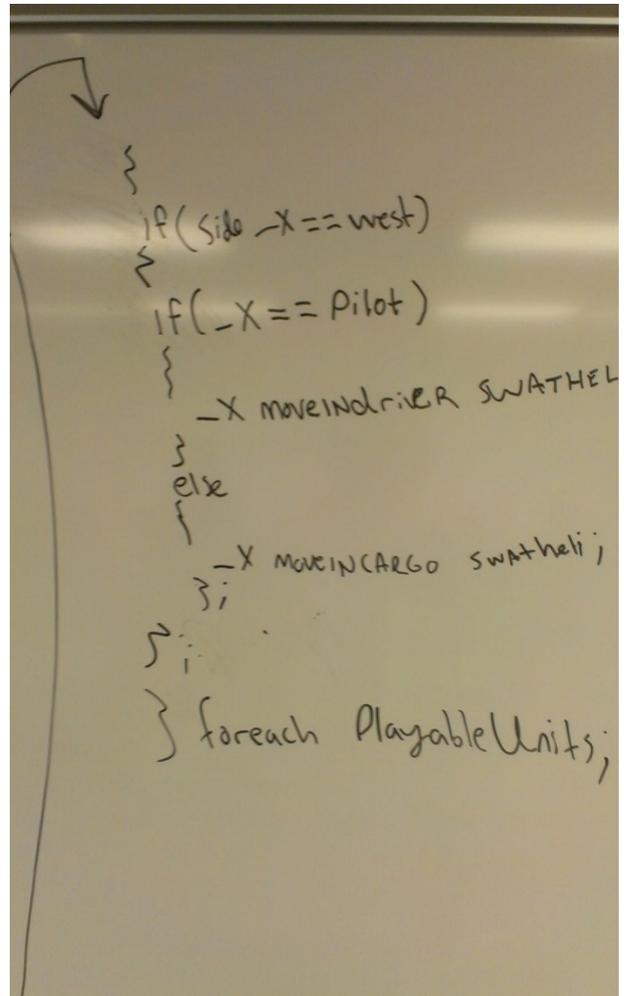


Figure 6: Dots representing all possible locations for a round



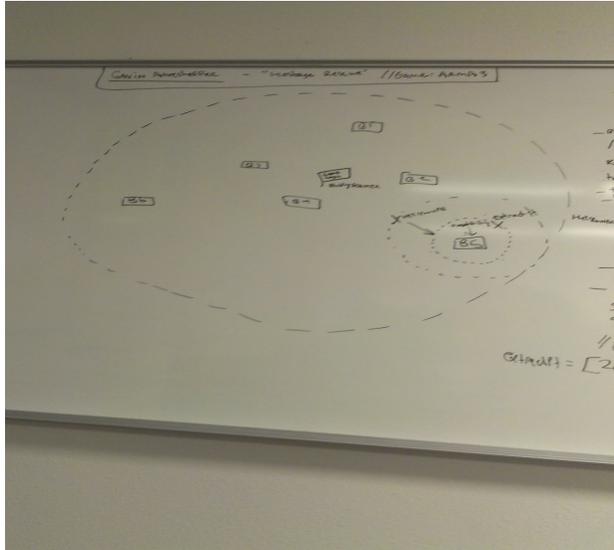


Figure 7: Whiteboard algorithm walkthrough

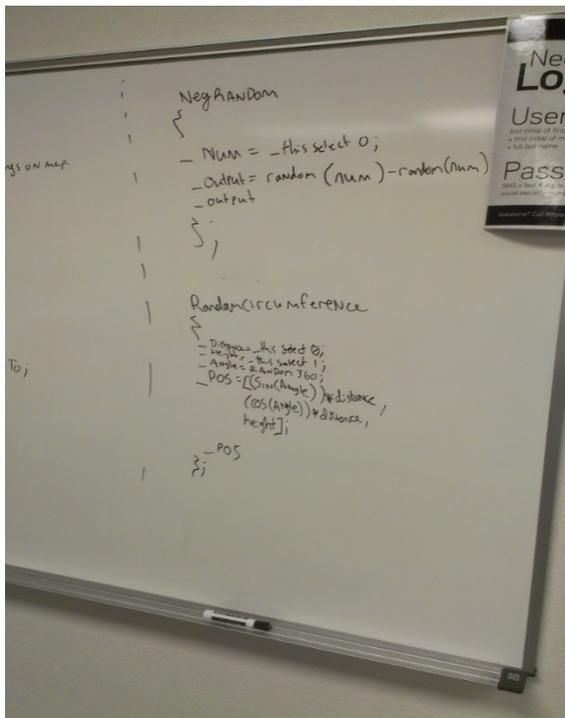


Figure 8: Whiteboard algorithm walkthrough



Figure 9: Rescue situation with the SWAT team helicopter.

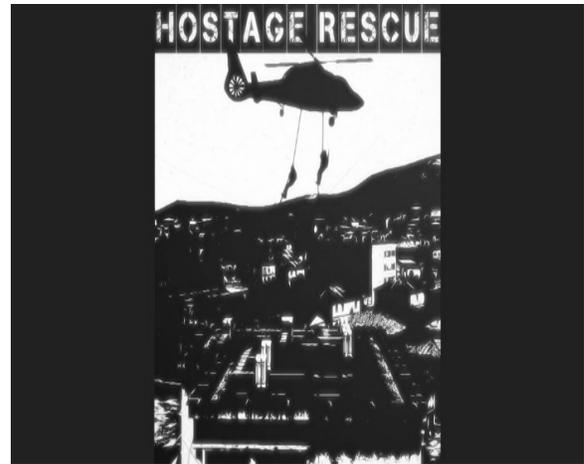


Figure 10: Rescue situation with the hostages being rescued by the SWAT team.



Figure 11: Rescue situation with the weapons view inside the SWAT helicopter.



Figure 12: Rescue situation with the weapons SWAT team loading in the helicopter.

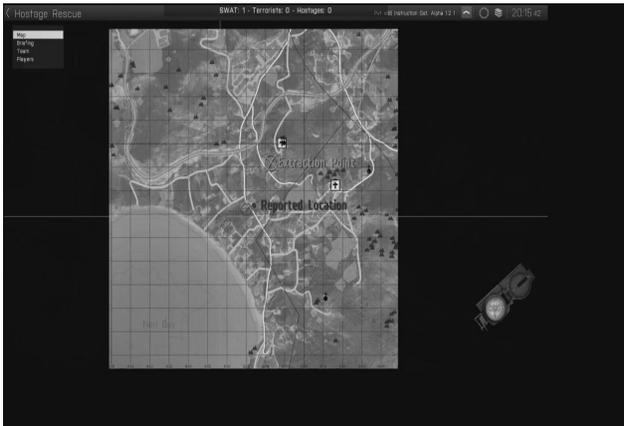


Figure 13: locations map.

[2] "ARMY.MIL, The Official Homepage of the United States Army." *Latest 'Virtual Battle Space' Release Adds Realism to Scenarios, Avatars*. N.p., n.d. Web. 14 June 2014.

[3] "Firefight Improvement System 2." *Bohemia Interactive Forums RSS*. N.p., n.d. Web. 14 June 2014.

[4] "Fire-Fight Improvement System." *Bohemia Interactive Forums RSS*. N.p., n.d. Web. 14 June 2014.

7. References

[1] <http://www.bistudio.com/> - Bohemia Interactive Studios

Hydraulic Fracturing: Processes & Impact. Pennsylvania Perspective

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Abstract

The purpose of the article is to review processes involved in drilling and hydraulic fracturing used by gas exploring industry. The reported processes of drilling and hydraulic fracturing involve monitoring and control that are electrically automated to a various degree. The article gives the historical background and economic impact of the natural gas exploration industry in Pennsylvania. In addition author shares his observations from visit to a drilling rig in the Marcellus Shale in South-Western Pennsylvania.

1. Introduction – A Brief History

Pennsylvania with its part of Marcellus Shale is experiencing a gas exploration boom shared with other parts of the country. The gas exploration regions in the continental USA are concentrated in various shale formations varying from North Dakota's Bakken Shale, Texas's Barnett Shale to Marcellus and Utica Shales in north-east of USA located in Ohio, Pennsylvania and New York states. There are smaller shale formations in other states as well. [1]

Although the first experimental use of hydraulic fracturing in United States was in 1947 and first commercially successful applications were in 1949, they benefited technologically from earlier attempts to use liquids to stimulate shallow hard rock oil wells in Pennsylvania, Kentucky, New York and West Virginia back in 1860s.[1-2]

The hydraulic fracturing was used successfully by other countries including the Soviet Union with first hydraulic fracturing performed in 1952, Norway, Algeria, and other countries as well.

The newer technology of hydraulic fracturing with horizontal drilling allows for recovering of huge volumes of gas from gas saturated sandstones of low permeability, which earlier was not viable economically. [1-4]

The first American company to apply the "massive" hydraulic fracturing was Pan American Petroleum in Oklahoma in 1968. Here massive fracturing involved injecting in excess of 150 tons of material into a well. By 2012, over 2.5 million hydraulic fracturing operations have been performed on oil and gas wells worldwide, more than one million of them in the United States. [1-2]

2. Hydraulic Fracturing

Huge discovery of gas deposits in shale formations in the continental U.S. combined with the progress in drilling technologies allowed for rapid growth of gas exploring industry and in gas production itself. Hydraulic fracturing technique combined with horizontal drilling facilitated conditions for access and recovery of deposits unreachable before. [1-2]

Hydraulic fracturing or commonly known as "fracking" is essentially a process of fracturing of the rock formations using a pressurized liquid in order to release deposits of oil and gas. A pressurized liquid is injected into a drilled hole at the completion of drilling process. The liquid used in the process typically consists of water mixed with sand and added chemicals, which is injected at

high pressure into a wellbore. The pressurized liquid is supposed to create small fractures (typically less than 1mm) in rock layers. During the process the hydraulic pressure is removed and small grains of proppant (sand) hold these fractures open to release the trapped gas. A proppant is a solid material, such as sand or other man-made material, which is used to keep an induced hydraulic fractures open. The fracturing fluids may vary in composition depending on the type of fracturing used. Fluids used in the process differ with respect to not only chemical composition but also material properties such as viscosity, acidity level, and other rheological factors. [1]

The injected liquids used by industry are source, currently, of growing public concern and controversy related to possible contamination of water wells and underground water reservoirs. [9]

3. A Visit to a Drilling Rig

The author visited one of the drilling rig facility in Marcellus Shale in Pennsylvania, Latrobe area, courtesy of Williams Corp., in Spring 2012 [See Appendix for site pictures]. Marcellus Shale geological rock strata formations that are circa 400 million years old contain natural gas below surface in depth varying between 4000 and 8000 feet.

The short visit was organized for an engineering faculty of local Penn State campus courtesy of Williams Corp., one of the gas exploration company. The motivation for a visit was to get acquainted with the drilling processes and in addition to assess the composition of the workforce employed and its educational needs.

The PSU local campus offers various engineering & technology oriented programs and the intention of the author was to assess the education needs which might be needed by the workforce employed at the drilling station. First, just a general impression: the place was vast and seems to be adequately set up and

organized. Drilling rig, on-site generators, open air liquid containing facility, storage for hardware/drilling pipes, etc., were all placed according to a well designed plan and layout, which naturally took local topography into consideration.

The drilling process itself is controlled from a small control room/cabin adjacent to an actual drill assembly. The room is equipped with many monitoring panels with monitors and control indicators. The worker who performed duties of the operator was in his twenties and in order to prepare to perform job responsibilities went through internal training at the drilling company. Interestingly, when asked about his educational background by the author, the operator responded that he was pursuing an electrical engineering degree on a part time basis.

The whole drilling enterprise was run by an engineer, namely a petroleum engineer with a long, over 30-years experience in petroleum & chemical exploration industry. Most of the workforce came from out of state: Wyoming, Oklahoma, Texas, and others, and underwent just on the job training. So it became rather obvious to the visiting team that there would be only very limited need for any educational programming from local university. Majority of the education would be sufficiently satisfied by a non-degree educational training.

The local PSU campus offers various engineering & technology oriented programs including mining technology which considers adding options that would address new local needs. The PSU internal report written by the author in 2010 performed a market study with over 200 local companies being surveyed to assess the needs for any interest in educational programs to be offered by a local PSU campus. The industry expressed an interest in a BS Electro-Mechanical Engineering Technology (EMET) degree program, and any other program including energy related one received only very limited interest. [7]

As mentioned above, the majority of the workforce in the gas drilling came from out of state and majority have just on the job training for predominately manual work. The exploration

drilling company outsources other needed services such as transportation and other specialty services.

4. Automated Control Processes

There is a variety of processes used in drilling that are automated to a various degree. On one hand there are plain direct control processes on the other many processes are partially or fully automated with precise control and monitoring through electrical/electronic means.

The most important processes involved in drilling and hydraulic fracturing, which are predisposed for either semi or fully automated monitoring and control are:

- Monitoring of the drilling process: depth and pressure,
- Chemical composition of injected liquid,
- Drilling mechanics information: Measurement While Drilling (MWD) also known as Logging While Drilling (LWD) measurements provide information about wellbore (the hole) inclination from vertical, magnetic direction, etc.

Collected MWD information provides data about the conditions at the drill bit location. This usually includes:

- Rotational speed of the drill string,
- Smoothness of the rotation,
- Type and severity of any down-hole vibration,
- Down-hole temperature,
- Torque and weight on bit, measured near the drill bit,
- Mud flow volume,
- Mud motor and MWD,
- Density and porosity,
- Rock fluid pressures, etc.

The multi-facet monitoring of the drilling process allows the operator to drill the well more

efficiently and to ensure that equipment is operated within their technical specifications to prevent not only tools failure but major technical disasters. Some collected information is also valuable to geologists responsible for the well

information as it relates to the geological formation being drilled.

Naturally, the safety of operations is a big concern so the multi-facet instrumentation and control schemes used take advantage of various level of automation to address this concern. Furthermore, the inclusion of automation improves efficiencies and ensures meeting control and processes specifications.

5. Economic and Environmental Impact

As many publications and documentation reported, the economic impact of fast growing natural gas exploration industry is already significant and far reaching in its impact. As local communities where drilling takes place are experiencing positive economic impact, the results in their aggregate affect the national economy. The Perryman Group report [3] identifies three types of economic activities related to gas and its share of overall economic activity that includes employment impacts as follows:

- Exploration, drilling and operations (67% of Gross product),
- Leasing and royalties (11% of GP),
- Pipeline infrastructure (22% GP).

With regard to Pennsylvania, recently, Rose Baker and David Passmore [4-5] provided extensive study on economic and environmental impact of natural gas industry. They stated in their report: "...during 2010 Pennsylvania Marcellus Shale natural gas development generated \$11.2 billion in value added,....contributed \$1.1 billion in state and local tax revenues, and supported nearly 140,000 jobs." The jobs most supported by gas industry, reported in the report are: construction, mining, wholesale trade & retail trade, in that order. The positive effects are not limited to the listed areas.

According to the report: “Marcellus natural gas production generated jobs in every major industry operating in Pennsylvania.” Further, report states that it is anticipated that type of economic impact and industries affected “will change as the gas industry matures.” So, the results of the natural gas

industry permeates through all sectors of economy and is felt in almost all areas of commonwealth life.

There are environmental considerations that are being raised not only by communities where natural gas exploration takes place but also by national agencies regarding water quality and air pollution [9-10-11]. While industry stresses the long history of safe operations with regard to maintaining water quality, independent sources do report occasional problems [9]. Industry provides technical expertise on proper well casing, which should prevent contamination of ground water but naturally the world of technology cannot guarantee fault proof processes. EPA proposes for first time to control air pollution at oil and gas wells as it responds to pressure from environmental groups, which sued agency in 2009 to force it to act. The agency extends its studies to quality of water as it might be affected by hydraulic fracturing [11].

6. Conclusion

The purpose of the article was to review processes used in natural gas industry in Marcellus Shale, which are subject to automation to a varying degree. The information is used in electrical engineering technology program as illustrations of instrumentation and control of industrial processes. An economic impact and the educational needs of the workforce employed by drilling industry were of interest to author.

References

1. <http://www.energyfromshale.org> March 2014.

2. <https://www.asme.org/engineering-topics/articles/fossil-power/fracking-a-look-back> May 2014.
3. <http://extension.psu.edu/natural-resources/natural-gas/issues/economics> (May 2014)
4. Rose Baker & David Passmore.”Reverse engineering the economic impacts of the PA
5. Marcellus natural gas industry.” Marcellus Business Central. A publication of PA Business Central. Vol 1, No. 3. August 12, 2011. Page 7. www.PaBusinessCentral.com
6. Rose Baker & David Passmore. <http://MarcellusShale3rd.notlong.com>
7. Timothy J. Considine, Robert Watson and Seth Blumsack.”The Pennsylvania Marcellus Natural Gas Industry: Status, Economic Impacts and Future Potential.” July 20, 2011. <http://marcelluscoalition.org/wp-content/uploads/2011/07/Final-2011-PA-Marcellus-Economic-Impacts.pdf>.
8. A. Gapinski. “Community Study to Assess Educational Needs for BS Degree programs in Engineering and/or Energy.” PSU-Fayette. Internal Report Nov. 2010.
9. Brock Pronko.” Banking on Marcellus.” Marcellus Business Central. A publication of Pennsylvania Business Central. Vol 1, No. 3. August 12, 2011. Page 15. www.PaBusinessCentral.com
10. “Water Quality.” http://www.oilandgasbmps.org/resources/water_quality.php University of Colorado. March 10, 2014.
11. Daniel Nestlerode. “Water quality and natural gas development.” Marcellus Business Central. A publication of Pennsylvania Business Central. Vol 1, No. 3. August 12, 2011. Page 3.
12. Dina Cappiello.”EPA targets air pollution from gas drilling boom.” Marcellus Business Central. Vol 1, No. 3. August 12, 2011. Page 15. www.PaBusinessCentral.com.

Appendix



Fig. 1 Natural gas drilling rig. Author took a photo while visiting a drilling rig in Marcellus Shale, Latrobe Pennsylvania.

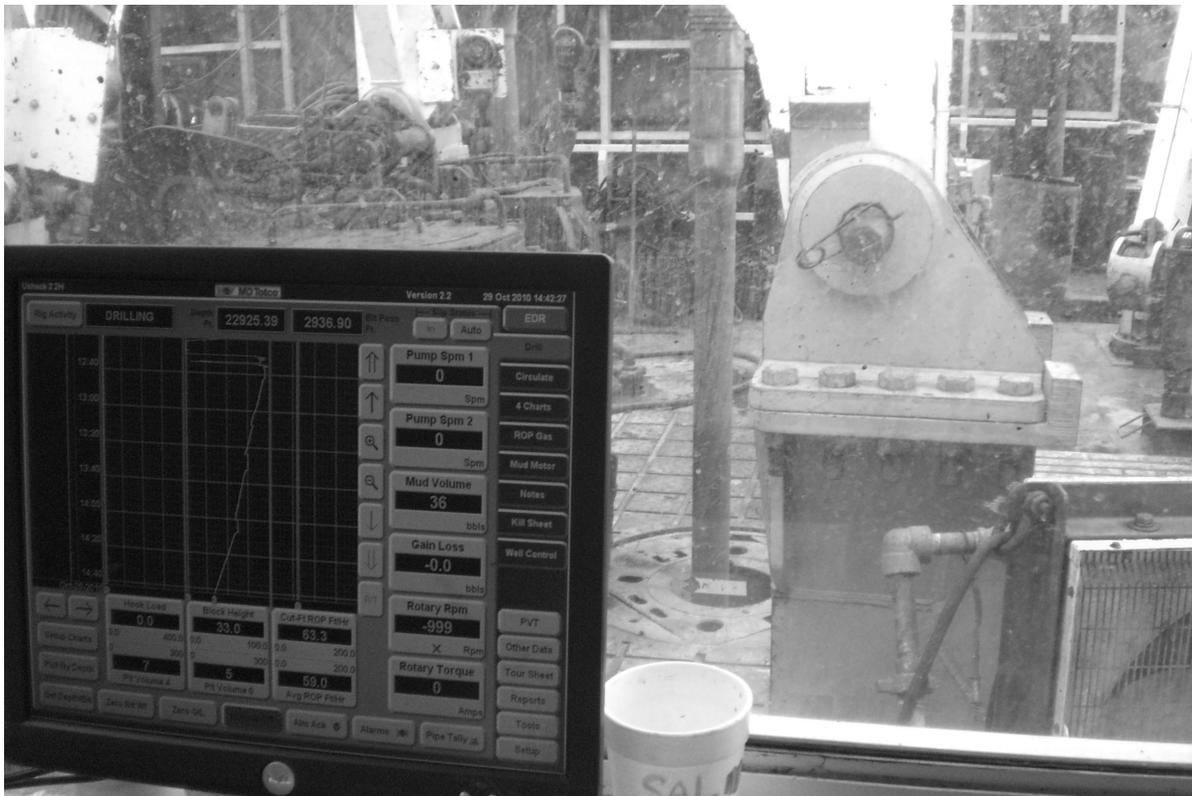


Fig. 2. Rig Control Room. Author took a photo while visiting a drilling rig in Marcellus Shale, Pennsylvania. Behind the glass window there is a visible drill assembly.

Layoffs as an Effective Restructuring Mechanism for Corporations

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Abstract

Reduction-in-Force (RIF) programs are one method companies utilize to cut operating expenses quickly. Such programs are often one of the few choices available to firms when revenues fall rapidly and unexpectedly. These programs encompass a range of initiatives including voluntary offerings such as early retirement to involuntary steps such as layoffs. Layoffs are typically the easiest and fastest way to cut operating costs and are perceived as an action that will positively impact the profitability of a company and the associated stock performance in the short-term. Studies have looked at the long-term implications on firms and found them to be negative in several areas. For example, past studies have found impacts on the workforce left behind, on the ability to recruit and retain talent, on the discretionary effort that may be expended by the personnel, and on the real long-term impact to the corporate earnings and the stock performance. However, what about the short-term which CEOs and other officers are often quite concerned?

This paper presents the short-term results of five major U.S. firms that initiated sizable layoffs during the period 2008-2010. An analysis of the stock performance of these five companies was done by comparing the performance of these five firms against other competitor companies from within the industry that experienced virtually no major layoffs. These results showed that a firm's short-term stock price may well not be impacted by a layoff of more than 3%.

BACKGROUND

A number of driving forces can impact a company, including those anticipated and those that are sudden and unexpected. For many industries, the human capital may represent the majority of the annual operating expenses. A deteriorating operating margin caused by an unanticipated reduction in revenues or uncontrollable cost increases may force a company to trim its' labor costs. If the expense reductions have to be made quickly, the company will need to consider workforce reduction strategies. One of these strategies is

layoffs. How should a company analyze all the ramifications of such a move?

One of the authors (Arbogast) lived through massive layoffs when he was serving as the Vice President of Systems Technology at a Fortune 50 company in the 1991-1994 timeframe. At the time deregulation was coming to the telecommunications industry and it was about to hit Pacific Bell which had a monopoly on all local traffic in the nation's largest state-California. The chief officers and strategists of the company decided that competition was coming fast and that they needed to take decisive action to avoid major consequences. Specifically, they decided to commit major resources to technology to erect high barriers

to entry for any other telecommunications company that would try to compete in the state once the government imposed de-regulation (it came in 1996). Approximately \$3billion was committed to put fiber optic lines throughout the state, digitize the older analog switches, and for similar other technological upgrades. Immediate consequences were felt throughout the company. The Systems Technology Group which the author had just taken over in early 1991 had 1950 employees at the time. Concurrently with committing the money for the upgrades, it was determined by the officers of PacBell that revenue would need to be recovered by offsetting operational losses. Layoffs were selected as the primary way to do this. Within a year there were three successive layoffs which took the Systems Technology Group down to 1250 personnel – a 36% reduction. This occurred with virtually no loss of mission or taskings to the Group. Similar major structural units (Engineering, Marketing etc.) received similar cuts. Personnel that departed were given company packages so it was often the most experienced and valuable Information Systems knowledge workers that departed. Scarce skills such as Data Base Administrators were particularly hard hit. Shortly thereafter, the company realized that the massive layoffs were having a major negative impact on the company and it agreed to an ill-advised merger with the Southwest Bell Corporation (SBC) under CEO Edgar Whitacre. The upshot was that this turned into an acquisition which Whitacre used as a template to take over other major firms such as Bell South and ultimately, AT&T itself. Bell Atlantic undertook a similar strategy in putting together Verizon out of such companies it acquired such as NYNEX and GTE. What can be learned from such examples?

Specifically, should it just be the long term results of layoffs that should be studied or is it not shortsighted to also review the short term impact of such layoffs. Previous research has centered on the long-term implications of the company's recruitment, retention, and discretionary efforts of its workforce with regard to layoffs? This research looks also at the short term consequences of such layoffs.

The Bureau of Labor Statistics requires companies to report mass layoff events. The Mass Layoff Statistics (MLS) program collects reports on layoffs for establishments which have at least 50 initial claims for unemployment insurance filed against them during a 5-week period ("Mass layoff statistics," 2013). The databases provided from this reporting accumulates statistics by industry and by reason for the layoffs. It is a rich resource of layoff events in the United States. Interestingly with the 2013 sequestration cuts this program will be eliminated this year ("BLS 2013 sequestration information," 2013).

Layoff statistics for 1996-2012 are included in Appendix A. The largest number of events and claimants occurred in 2009 followed by 2008 for a total of over 4 million of claimants ("Bls news release," 2013). This was the period utilized to conduct research on the stock performance of companies that were part of these large layoffs.

Unintended consequences of layoffs can include a decrease in staff morale impacting productivity, difficulty in future recruitments, high costs of severance payments and outplacement programs, loss of key knowledge, and of course a reduction in trust and credibility. (Bergfeld, 2008).

What other strategies can a company consider before resorting to layoffs? Can it look at restructuring, selling off business lines,

utilizing a base of outsourced arrangements that can be adjusted with varying volumes. What more can it do to anticipate changes in its operating performance to achieve the reductions through attrition and other initiatives? An article published by Franco Gandolfi, a professor of management at Regent University outlined a framework with over eleven steps a firm, with financial challenges, can take prior to initiating layoffs. These include steps that will support short term cost reductions such as hiring freezes, mandatory vacation, reduced workweek/overtime, and salary reductions and then medium range cost reduction steps such as voluntary sabbaticals, employee lending, and exit incentives such as optional severance or early retirement. (Gandolfi, 2008).

The identification and measurement of the unintended consequences of layoffs is not within the scope of the quantitative research conducted for this paper. However based on the literature review of layoffs, a company is wise to consider all ramifications and assess the impacts prior to making a move to eliminate employees.

How does a company measure the true impact of any increase in shareholder value following a layoff? What is the correct measurement period to review all implications of such a move? If the stock value does improve could it have related to other non-layoff elements? These are important questions to answer in order to formulate future strategies and moves. A review conducted by Marc Bastow of InvestorPlace of four companies that initiated layoffs in 2012 showed that the financial performance had not improved following the event. These included Hewlett-Packard, JCPenney, Citigroup and PepsiCo. According to Bastow “you can’t cut your way to

prosperity” (Bastow, 2013). A study covering a longer period of measurement (six years) than the Bastow review, published in 2006 by Gyu-Chang Yu and Jong-Sung Park and covering over 250 Korean companies concluded that the overall performance of the companies using the layoff tactic declined compared to the companies that did not implement layoffs (Yu & Park, 2006).

PROBLEM STATEMENT– HYPOTHESES

A company must contemplate all of the strategies and driving forces previously mentioned. A firm’s performance following a layoff can be measured by reviewing the change in stock price during a specified short period after the layoff occurs.

This study analyzes the relationship between the stock performances of Fortune 500 companies in five industries. The following is the hypothesis used for this research:

- ❖ Null Hypothesis – A firm’s stock price performance is not impacted in the short run following a layoff of more than 3% of its workforce.
- ❖ Alternative Hypothesis – A firm’s stock price performance in the short run may be impacted following a layoff of more than 3% of its workforce.

The results of the test will allow: (1) to reject the null hypothesis; or (2) the ability to fail to reject the null hypothesis in favor of the stated alternate hypothesis.

RESEARCH DESIGN AND METHODOLOGY

DailyFinance.com, a subsidiary site of AOL.com, published an article titled “The Layoff Kings: The 25 Companies Responsible for

700,000 Lost Jobs” late in 2010. (McIntyre, 2010). In this article, the author provides data regarding the top twenty-five U.S. companies that conducted layoffs in their organization for the period 2008 – 2010. For this research, five of the companies referenced in the article were selected for the analysis. In selecting the companies to model, the following criteria were utilized:

- ❖ Publicly traded
- ❖ Layoffs were not the result of an industry wide event
- ❖ The company was a member of the Fortune 500 in 2008
- ❖ Layoffs exceeded 3% of the overall employee base

Table 1. Companies and Industries selected

| Company | Industry | Layoff % | Fortune 500 rank (2008) |
|-----------|----------------|----------|-------------------------|
| Boeing | Aircraft Mftr | 6.2 | 27 |
| Alcoa | Aluminium | 15.5 | 80 |
| Dow Chem | Chemicals | 10.9 | 42 |
| CitiGroup | Financial Svcs | 12.9 | 8 |
| StarBucks | Specialty Food | 3.4 | 277 |

Additionally, a second company in each industry was selected to act as a control for comparison purposes. The five control companies were selected as a control for the analysis:

Table 2. Control Companies

| Company | Industry |
|----------|------------------|
| Lockheed | Aircraft Mftring |

| | |
|------------------------------|-------------------------|
| Martin | |
| Aluminum Corp. of China Ltd. | Aluminum |
| DuPont | Chemicals |
| Bank of America | Financial Services |
| McDonalds | Specialty Food Retailer |

For each of the companies, data regarding the daily closing price for the first trading day of each month between January of 2006 to December of 2011 was obtained. The percentage change in each company’s stock price for both the target companies, as well as the control companies, was calculated on a month to month basis. At this point, the monthly difference in the control company’s stock price was subtracted from the target company’s monthly difference in stock price to generate the overall difference between the target and control company’s monthly stock price. Lastly, a dummy variable was created to indicate if the layoff had occurred. The dummy variable was set at zero in the months preceding the layoff and set to 1 for the month of the layoff and beyond. Below is an example of the data utilized, where Boeing’s layoff occurred in October of 2008:

Table 3. Stock Price Change (by month)

| Month 2008 | Boeing month stk % pr chg | Lockheed month stk % pr chg | Difference (%) | Dummy Layoff Variable | Variable in Model |
|------------|---------------------------|-----------------------------|----------------|-----------------------|-------------------|
| July | -7.01 | 5.75 | -12.76 | 0 | 1 |
| Aug | 7.28 | 11.61 | -4.33 | 0 | 1 |

| | | | | | |
|------|--------|-------|-------|---|---|
| Sept | -12.52 | -5.81 | -6.71 | 0 | 1 |
| Oct | -8.60 | -22.4 | 13.85 | 1 | 2 |
| Nov | -18.68 | -9.34 | -9.34 | 1 | 2 |
| Dec | 0.09 | 9.04 | -8.95 | 1 | 2 |

EXERCISE MODEL/DESCRIPTIVE STAT

The model used a homoscedastic t-test to determine whether the stock prices were likely to have come from distributions with equal population means. One variable being the month over month difference in the stock price of the layoff companies versus the control company before the layoff, and the other variable being the monthly stock price difference of the layoff company versus the control company post layoff. Note that the emphasis is on the short term relationship since the results involve only those months immediately before and after a layoff. Also, the value for alpha (α) is 0.05. Using the data collected, the model incorporates 69 different observations, which meets the established criteria for a statistically relevant population.

RESULTS

The charts in Appendix C indicate the percent change of the stock price performance between the target and the control companies. The red line indicates the date the layoff occurred and the green line shows the linear difference. The charts also indicate the performance of the S&P 500 during this time period.

The findings from the homoscedastic t-test of the five different industries was inconclusive. The analysis showed a failure to reject the null hypothesis in four of the industries (Aluminium, Chemicals, Financial Services, Specialty Food Services). With the data examined, an impact

between the target and control groups' changes in stock price was not present. However, the ability to reject the null in one industry (Aircraft Manufacturing) was present. It should be noted that the magnitude of the layoff was not tested. Further testing could be done evaluating whether there is a correlation between the magnitude of the layoff (over greater than 6% of the workforce) and the change in stock performance.

CONCLUSIONS

In conclusion, companies have few strategic choices when revenues decrease in an unacceptable manner. . This research paper looked at the impact of one of these choices – layoffs. Specifically, the concern was on the stock performance of firms in the short-term. The research analyzed the change in stock performance over five years for 10 companies across five industries. Unfortunately when looking across five major industries (ten companies), there was no real perceptible trend i.e. mixed results were noted. In only in one industry was there any indication that there may well be a relationship between layoffs and financial performance in the short-term (Aircraft Manufacturing), However, in four other industries (Specialty Foods, Aluminum, Financial Services and Chemicals) there did not appear to be any statistical evidence that a relationship existed between layoffs and financial performance. Thus, the overall results of the study proved to be relatively inconclusive.

RECOMMENDATIONS

Companies have to consider all of the ramifications to the stock performance when it comes to layoffs. Shareholder value after layoffs is one concern for most firms. Studies of firms

and stock price performance have been done in various countries. Often, these studies did not appear to compare more than one company across industries. This study compared two companies from five industries. The findings showed that in four industries the impact was inconclusive. Although, with the two tailed t-test, one industry with small layoffs (less 6%) showed an impact on short-term stock price performance. To accurately identify if the layoffs have the strategic performance expected, studying the magnitude of the layoff should be evaluated for impact. The finding of a new study could provide the information necessary for a company to decide which is more beneficial: a massive layoff or smaller layoffs over an extended period of time.

Furthermore, this study only reviewed five industries. In this study, the S&P 500 was plotted on the charts so an overall stock market comparison could be made. Another recommendation is to review more than five industries with various layoff sizes. This may answer the question of whether these findings were based on the magnitude of the layoff or if the differences were industry specific.

References

- Bastow, M. (2013, January 16). These 4 companies aren't much better after big layoffs. Retrieved from http://www.bls.gov/bls/sequester_info.htm
- Bergfeld, Carlos (2008), The Hidden Costs of Layoffs, Moneywatch, CBS Interactive, Inc. June 23, 2008.
- Bls news release. (2013, April 10). Retrieved from the following website: http://www.bls.gov/news.release/archives/mslo_02142013.pdf
- Caggiano C, Cannella C. Now, Manage, Dammit. Inc [serial online]. October 15, 2002;24 (11): 73. Available from: Academic Search Complete, Ipswich, MA. Accessed March 12, 2013
- Feldt, J. A., & Andersen, D. F. (1982). Attrition Versus Layoffs: How to Estimate the Costs of Holding Employees on Payroll When Savings are Needed. *Public Administration Review*, 42 (3), 278-282.
- Gandolfi, F. (n.d.). Hr strategies that can take the sting out of downsizing-related layoffs. (2008). *Ivey Business Journal*, Retrieved from <http://www.iveybusinessjournal.com/topics/strategy/hr-strategies-that-can-take-the-sting-out-of-downsizing-related-layoffs>
- Greenhalgh, L., & Mckersie, R. B. (1980). Cost-Effectiveness of Alternative Strategies for Cut-back Management. *Public Administration Review*, 40(6), 575-584.
- Hallock, K. F. (1998). Layoffs, Top Executive Pay, and Firm Performance. *American Economic Review*, 88(4), 711.
- Hitt, M. A., Keats, B. W., Harback, H. F., & Nixon, R. D. (1994). Rightsizing: Building and Maintaining Strategic Leadership and Long-Term Competitiveness. *Organizational Dynamics*, 23(2), 18-32.
- Lee, P. M. (1997). A comparative analysis of layoff announcements and stock price reactions in the united states and japan. *Strategic Management Journal* (1986-

1998), 18(11), 879-879. Retrieved from
<http://ezproxy.ju.edu:2048/login?url=http://search.proquest.com/docview/231086127?accountid=28468>

<http://www.deepdyve.com/lp/emerald-publishing/the-effect-of-downsizing-on-the-financial-performance-and-employee-hHHOnT8Zwr>

Mass layoff statistics. (2013, April 10). Retrieved from <http://www.bls.gov/mls/>

McIntyre, D. (2010). The Layoff Kings: The 25 Companies Responsible for 700,000 Lost Jobs. Retrieved by <http://www.dailyfinance.com/2010/08/18/the-layoff-kings-the-25-companies-responsible-for-700-000-lost/>

APPENDICES

Orazem, P. F., Bouillon, M. L., & Doran, B. M. (2004). Long-Term Attachments and Long-Run Firm Rates of Return. *Southern Economic Journal*, 71(2), 314-333.

Perry, L. (1986). Least-Cost Alternatives To Layoffs In Declining Industries. *Organizational Dynamics*, 14(4), 48-61.

Pheffer, J. (2010, February 15). Lay off the layoffs. *Newsweek*, 155(7), 32-37. Retrieved from <http://mv.ezproxy.com.ezproxy.ju.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=48026283&site=ehost-live>

Stanley D. TRYING TO AVOID LAYOFFS. *Public Administration Review* [serial online]. September 1977;37(5):515-517. Available from: Business Source Premier, Ipswich, MA. Accessed March 12, 2013.

Topel, R. H. (1982). Inventories, Layoffs, and the Short-Run Demand for Labor. *American Economic Review*, 72(4), 769.

Yu, G., & Park, J. (n.d.). The effect of downsizing on the financial performance and employee productivity of Korean firms. (2006). *International Journal of Manpower*, 27(3), Retrieved from

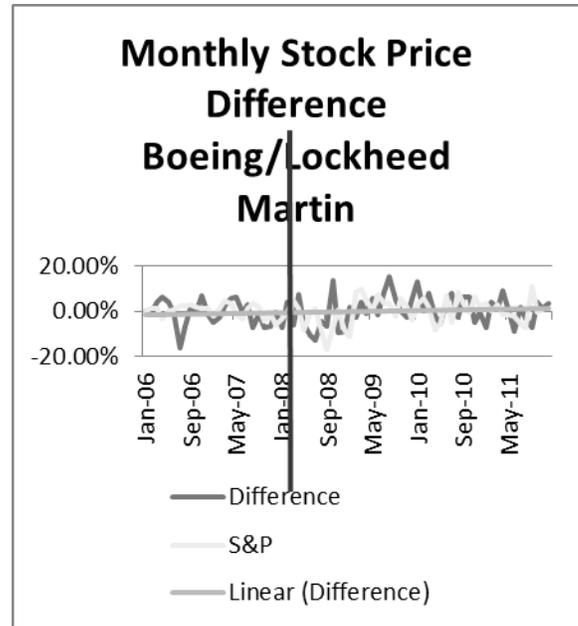
Appendix A Bureau of Labor Statistics – Mass Layoff Statistics

Table C. Selected measures of mass layoff activity, 1996-2012

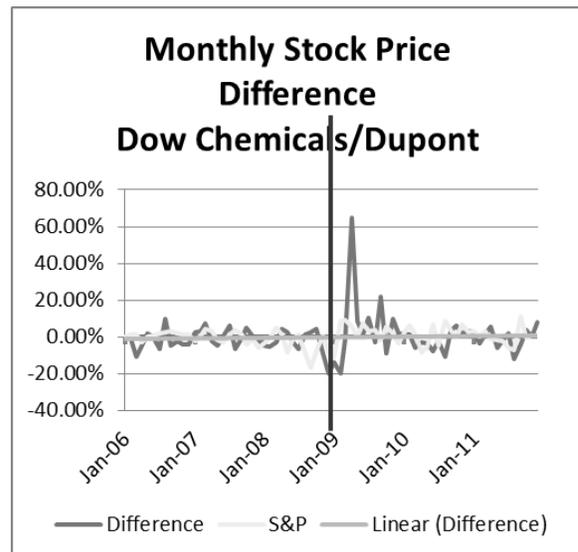
| Period | Layoff events | Separations | Initial claimants |
|-------------------------|---------------|-------------|-------------------|
| 1996 | 4,760 | 948,122 | 805,810 |
| 1997 | 4,671 | 947,843 | 879,831 |
| 1998 | 4,859 | 991,245 | 1,056,462 |
| 1999 | 4,556 | 901,451 | 796,917 |
| 2000 | 4,591 | 915,962 | 846,267 |
| 2001 | 7,375 | 1,524,832 | 1,457,512 |
| 2002 | 6,337 | 1,272,331 | 1,218,143 |
| 2003 | 6,181 | 1,216,886 | 1,200,811 |
| 2004 | 5,010 | 993,909 | 903,079 |
| 2005 | 4,881 | 884,661 | 834,533 |
| 2006 | 4,885 | 935,969 | 951,155 |
| 2007 | 5,363 | 965,935 | 978,712 |
| 2008 | 8,259 | 1,516,978 | 1,670,042 |
| 2009 | 11,824 | 2,108,202 | 2,442,000 |
| 2010 | 7,247 | 1,257,134 | 1,415,766 |
| 2011 ^r | 6,596 | 1,112,710 | 1,295,273 |
| 2012 ^p | 6,051 | 1,152,258 | 1,177,143 |

^r = revised.
^p = preliminary.

Appendix B Monthly Stock Price Difference Boeing/Lockheed Martin



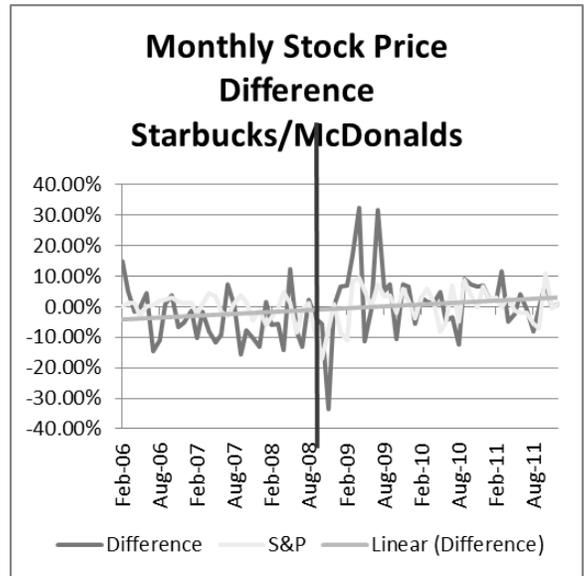
Appendix C Monthly Stock Price Difference Dow Chemical/Dupont



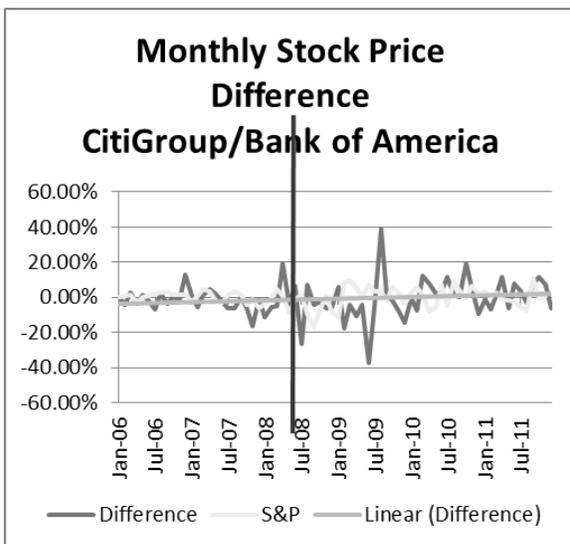
**Appendix D Monthly Stock Price Difference
Alcoa/Aluminum Corp of China**



**Appendix F Monthly Stock Price Difference
Starbucks/McDonalds**



**Appendix E Monthly Stock Price Difference
CitiGroup/Bank of America**



Maintaining Thematic Consistency within Mobile Content Adaptation

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Abstract

The mobile web presents many challenges for users and developers alike. It is difficult to properly craft an acceptable user experience given the constraints of mobile devices. A developer might choose to create an alternative version of their site from scratch, which can be time-consuming and labor intensive. They might also rely upon modern mobile browsers to handle the legwork, displaying web pages “as is”. Ideally, a mobile site should be designed to enhance a mobile user’s experience rather than serve up content designed for desktops. In order to facilitate this process, a number of frameworks and mechanisms have been created to optimize the user experience. The following paper presents a study of techniques for “content adaptation”, the process of reformatting content from desktop sites and displaying them optimized for the mobile. This process is based on a number of factors including hardware constraints, software constraints, user preferences, location, and latency. Included in this discussion is a summary of the advantages and disadvantages of current techniques. A new framework is presented as a solution that combines content adaptation with prioritization to provide users with pertinent and usable information. In particular, this discussion focuses on enhancements to account for thematic consistency. Adaptation algorithms generally do not account for site-wide thematic elements like headers and logos, which may get lost in the conversion. Proper branding and site identification are important for the users to keep context within a complex site.

1. Introduction

Usage of the Mobile Web has grown exponentially, so much so that it is predicted to overtake desktop usage in 2014 (Cisco, 2013). Despite this widespread adoption rate, the Mobile Web still suffers tremendous challenges in usability, just as the original Web did back in the mid 1990’s. The Mobile Web has to contend with a number of issues, including different platforms, devices, and a lack of standardization. It can difficult just getting a web site to appear on a mobile device, let alone making it “usable”. Today’s smartphones are

slowly improving device accessibility, but usability factors are still lagging behind.

The preferred method for developing a mobile site and maximizing usability has been to build it from the ground up. In this manner, developers can understand what users require from a mobile perspective and adapt their site to fit those needs. The best performing web sites are those that are manually crafted (Borodin, Mahmud, and Ramakirshnan, 2007). However, this requires extensive development time and effort.

2. Content Adaptation

Web pages can be seen as collections of content, such as search input, blog posts, comment boxes, etc. The process of altering page and content structure to enhance the user experience on mobile devices is called content adaptation (W3C, 2013). Content adaptation involves the production, selection, and modification of content data to satisfy constraints or attributes unique to that device. These factors could include hardware constraints, software constraints, user preferences, environment variables, and network latency. Intelligent content adaptation is difficult to do; it is usually a manual process. Today's mainstream autonomous solutions only achieve device accessibility where content is only adapted to be displayed on a device, not necessarily whether the presentation makes sense to the user.

3. Adaptation Techniques

A number of techniques have been developed to adapt mobile content without the need for manual interaction. These techniques focus on making content more "friendly" to mobile devices. This could range from simple accessibility checks to full redesign. Reformatting content may consider a number of variables and factors, such as screen dimension, but also underlying intrinsic variables, such as user behavior, context, semantics, and statistics.

Filtering is one such adaptation mechanism that provides users only certain portions of a page. Filtering extracts and removes web elements to minimize the amount of information sent over the network. Filter specifications are based off such information as search terms, personal web browsing history, and bandwidth demands. Myngle is an example

of a filter-based app that uses browsing history to deliver only the information most relevant to that user (Sohn et al., 2011)

Another technique, summarization, condenses information by redefining what is inside each web element. Summarization utilizes attributes such as web page titles, themes, keywords, metadata, tags, and captions (Ham et al., 2007). Unlike filtering, summarization retains all web elements while reducing the text for each element.

The concept of scaling, or magnification, is the most popular technique in today's smartphones, providing the ability to "zoom in" and magnify portions of an unaltered desktop site. For example, in Opera Mini it creates a thumbnail version of the entire site, shrunk to fit the mobile device screen (Opera, 2013). Users can then zoom to drill down to a subsection of the page. This approach only benefits users that are familiar with the desktop version of the site. For complex and content rich sites, the original format is generally not optimal for small screen viewing.

4. Mobile Content Adaptation and Prioritization Framework

The Mobile Content Adaptation and Prioritization (MCAP) framework was developed by the author as a solution to the issues facing content organization and adaptation on mobile devices. The MCAP framework is an autonomous, scalable framework that automatically converts web pages into optimized mobile sites. This is accomplished through a unique combination of content adaptation and prioritization.

Adaptation involves formatting the content, whereas prioritization focuses on determining the content's importance to the user. These two mechanisms provide an optimized list of

content blocks, focused particularly towards mobile users. This framework parses a site’s content and reorganizes and reformats each element to create the optimal experience.

The MCAP framework is a server-client approach; the adaptation is performed on the web host alongside the source files. This reduces user and developer impact, and provides a framework that omits the drawbacks of other approaches. It removes the need for a device dependent platform, and it can scale with the amount of implicit and explicit site context. This allows the framework to be easily deployed on any site, regardless of size and complexity.

5. Prioritization of Content

The most significant feature of the MCAP framework is its Content Order algorithm, a prioritization method by which content blocks identified in adaptation are ordered to deliver the most important content first. The Content Order algorithm is essentially a sorting mechanism. The input is an unordered list of content, as defined by the adaptation mechanism. The output is set of index positions for each content block. The function $P(C_n)$ represents the rank value of a content node “C” at a position “n” in the adaptation output. Each content block that is contained in a set of blocks receives a value between 1 and “n” as a result of a combination of calculated weight factors. Once every content node receives this value, the blocks are sorted in order of decreasing importance, with 1 being the highest importance and “n”, the total number of elements, being the content of lowest importance.

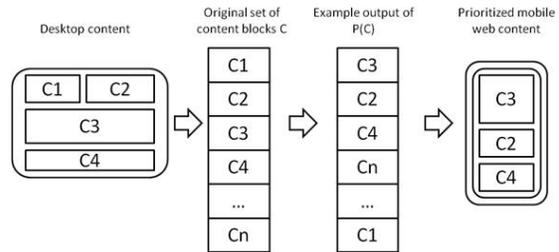


Figure 1. Illustration of reordered content blocks

The value of $P(C_n)$ consists of five individual prioritization calculations. These values represent different aspects of a content node, specifically the distance, function, semantic, time, and user properties. These properties are assigned as rank weights, which represent the percentage of emphasis placed on each separate prioritization calculation. By default, these weights are evenly distributed, but developers have the ability to configure which weights have precedence over others. The following section will provide a detailed discussion of the individual weights and their impact.

6. Weights

6.1. Distance Weight

Distance can be seen as the baseline importance of a content block as defined by the physical location it has on the page and in the source code. The value by which these nodes are assigned importance is a combination of Document Object Model (DOM) distance, where it appears in the logical source code, and geometric distance, the Cartesian coordinate position of the content on a web page. This combination reflects the node’s relative importance based on the developer’s original intent. Content that appears at the top of a page are the first elements a user sees. Therefore, this places more initial importance

on elements that appear first in the original source.

6.2. Function Weight

The Function weight interprets the role a specific content block has in the architecture of the page. This includes two sub-values, a redundancy calculation and context identification. The Function weights are calculated using page depth and heuristic classification in order to determine the content's intended purpose. Page depth describes how deeply nested in the overall site's hierarchy this particular content is. Heuristic evaluation involves the identification of content into types, such as "navigation" or "media", based off a set rubric.

The redundancy weight is of particular importance to the Function Weight calculation. A content block's priority is influenced by how frequently it appears across an entire site versus how deep in the site's hierarchy it appears. Redundancy is used to identify certain elements that are considered unnecessary when repeated across multiple pages. In a typical web site, these are often template elements, such as the header logo and navigation buttons. These elements do provide context for the user, but in the mobile environment, the repetition of every single element can become unnecessary. This raises the question of how much redundancy elimination affects the concept of thematic consistency. While logos and image branding may not serve a concrete role in usability, they may still be useful within the context of the site. Redundancy will play a large role in later discussion.

6.3. Semantic Weight

Semantic weights are associated with the text that comprises an individual content block. This weight places emphasis on keywords, include ones used implicitly in the source code, and those used explicitly by users searching for a particular phrase. The weight is calculated through a combination of "link strength", a measurement of the total number of links referencing a content block's topic, and "keyword strength", a measurement of the frequency and importance of keyword terms found in the content.

6.4. Novelty Weight

Novelty is a measurement of how recently a content block has been updated in comparison to surrounding page's content. An individual web page may go through multiple iterations during the course of time. However, most updates to pages only change a fraction of the entire page's content. Typically a single content block might be modified or added in between versions. Identifying these content blocks as "novelty" means they are of higher importance due to the frequency and occurrence of updates.

6.5. User Weight

The User weight represents any aspect of the individual user that is currently viewing a particular page. While the other four weights are primarily based on server-side information, the User weight relies on client-side context. Gathering detailed user information can be difficult on a mobile phone, though not impossible. A user agent string that is sent by a device for requesting mobile content provides a limited amount of user information such as browser and device type. Although this is

important for the adaptation mechanism, it does not provide many clues as to what content the user might deem important. User weight calculations rely on real-time data, rather than archived data for the previous weights, such as keywords and search terms. Additional context can be derived from advanced mobile features, such as the location of the phone from a phone's GPS unit.

7. Prototype

A functional prototype of the MCAP framework was developed to evaluate and test against a live site. PHP was chosen for the development of the prototype. PHP's open source nature, efficiency, ease of use, and wide acceptance by the web community made it an ideal candidate for development of the framework. PHP relies upon inbuilt memory space, which reduces the strain put on the server during processing time.

The MCAP framework operates autonomously; once installed the framework performs all operations itself and keeps processing indefinitely until told otherwise. While much of the information can be derived from the pages itself, the framework must be told explicitly where certain data is stored, such as keyword frequency and update metrics. The framework is installed by placing it at the root directory of the web site. Once installed, the framework catalogs the site hierarchy, finds web pages, and performs the adaptation and prioritization algorithms. Each page then receives a mobile counterpart, which gets relayed to mobile users once they access the site.

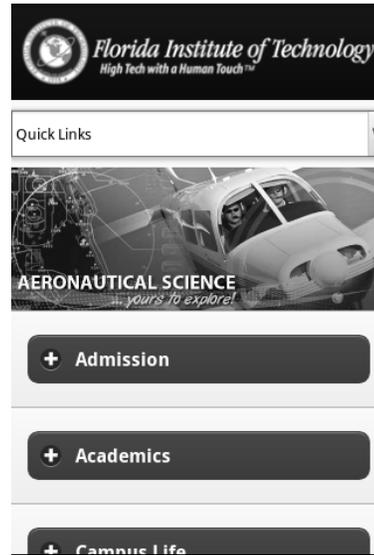


Figure 2. Example of MCAP run against a Florida Institute of Technology page

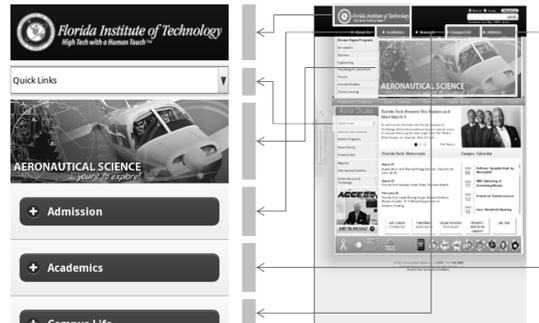


Figure 3. Illustration of the original source content as adapted to the mobile page

To verify the effectiveness of the MCAP framework, a case study using different mobile phones and users was conducted and analyzed. Three different devices were paired against ten user sets for MCAP and non-MCAP implementations. Participants were tasked with completing five scenarios using a university web site. In order to quantitatively measure the benefits of this framework over other approaches, the following major usability metrics were considered: learnability,

complexity, efficiency, error rate, and user satisfaction. These are based off Jakob Nielsen's five quality attributes (Sauro & Kindlund, 2005).

In general, the MCAP framework performed favorably against the usability metrics. MCAP performed particularly well in error rate, completion rate, and subjective analysis. Users were more likely to complete scenarios with fewer mistakes. Users found their objectives using fewer steps, even if the original site hierarchy remained the same. As a result of reduced error rates, MCAP users fully completed more objectives than their counterparts testing the original site.

8. Thematic Consistency

One particular area that gave users trouble in the original evaluation was the fluctuation of common element placement. The Redundancy weight was designed to push repeated elements further down a page the deeper that page was in the hierarchy. Therefore, elements on one page may not be in the same place on follow-up pages. Links and objects that were deemed redundant were placed lower in the content stack. These elements were typically thematic in nature, such as logos, which tend to be repeated often throughout a site. A page that is four or five levels nested and removed from the main entry page could see the logo placed almost near the bottom. The following figure shows an example of the university site without the standard logo which appears in previous figures.

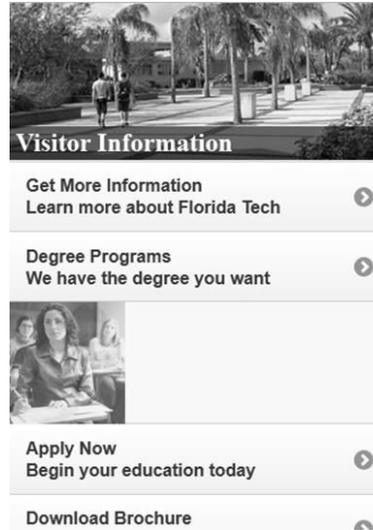


Figure 4. Example of MCAP output without thematic consistency (logo removed)

Lost thematic consistency can be a problem for companies that desire brand recognition. Maintaining a banner and logo on every page helps a company spread their identity. Each time a user views the logo they are automatically enforcing a bond between the company and consumer. In addition, these elements provide context to users of the site. The presence of the same logo ensures users understand which site they are on and if they have been redirected to an external location. It also generally provides navigational assistance; many logos and banners do double duty as a redirect link back to the home page.

There are several methods to identify elements as thematic, methods that were originally proposed in the redundancy and heuristic rule sets. Some clues that trigger elements as thematic include image names, link destinations, physical locations, and color selection. For example, a company like the Target Corporation has a distinctive red and white bulls eye logo located at the upper left quadrant of every page. Using these signals, the MCAP framework can eliminate the redundancy

penalty for these elements and preserve their original prioritization.

9. Evaluation

The prototype was reevaluated with the redundancy weight modified to account for thematic elements. In most usability metrics, there was little to no divergence, including error rate, page numbers, and completion rate. However, task duration was improved in four out of the five scenarios tested on the follow-up analysis. This may be due to the fact that thematic elements typically link back to the home page. In several complex scenarios users were required to move between many parts of the site. Headers and logos often act as a breadcrumb to lead users back to the main page, providing an anchor for which to base their navigation habits.

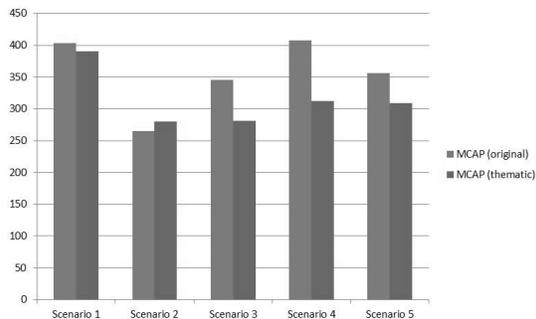


Figure 5. Task duration results (in seconds) with thematic consistency preserved

In all respects, the addition of thematic consistency pages retained the usability levels of the original MCAP calibration. Further adjustments may be necessary to refine the redundancy heuristic across different sites, but initial analysis seems to favor reduced emphasis on penalizing repeat elements.

10. Future Research

While the heuristics used in thematic consistency were adequate, there is more analysis that could be done to better define these elements. In particular, the concept of color sampling could be crucial towards identifying images as corporate branding. Image processing techniques could allow the framework to take a sample of the pixels in an image and identify candidate colors based off the percentage of use for certain RGB values. For example, a logo for Target Corporation would be rich in red on the RGB scale. As this color appears as a majority value across the site, it would further identify this image as a thematic element.

Furthermore, it could then feed them into a CSS generation mechanism to not only keep the original images, but enhance the mobile template by emphasizing the color scheme. This would further alleviate demands on the developer and make MCAP more scalable.

11. Conclusion

The MCAP framework was built to minimize impact on developers and users, while simultaneously providing a better user experience by prioritizing and formatting content intelligently. The initial prototype presented mobile friendly content to such a degree that it both quantifiably and qualitatively improved the usability of the site.

The initial algorithm was designed with a certain amount of scalability; as more information becomes available, more options open up to better define and prioritize content. At the very minimum, MCAP creates an optimized site with nothing more than the original source code. However, web pages can be complex and nuanced entities. Initial analysis showed that a blanket approach towards

redundancy led to a loss in thematic consistency. Thematic consistency can be crucial not only towards brand recognition, but site navigation and usage as well.

Reevaluating the redundancy mechanism allowed for an improved performance in task duration metrics. The preservation of thematic elements maintained a level of context for users which aids in navigation and site identification. It is likely that further adjustments and enhancements to the baseline Content Order algorithm will continue to improve the overall performance of the framework. As the MCAP framework was designed with scalability in mind, more attributes and adjustments can easily be dropped in with minimal disturbance. The goal is to provide developers with options as needed, but not to interfere with their mobile ecosystem. This design opens MCAP up to many possibilities in the future.

12. References

[1] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015. (2013). Retrieved February 12, 2014, from http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html

[2] Borodin, Y., Mahmud, J., and Ramakirshnan, I., "Context browsing with mobiles - when less is more" in Proceedings of the 5th international conference on Mobile systems, applications and services (MobiSys '07), New York, NY, USA, 2007, pp. 3-15.

[3] W3C Authoring Challenges for Device Independence. (2013). Retrieved December 18, 2013, from <http://www.w3.org/TR/2003/NOTE-acdi-20030901/>.

[4] Sohn, T., Chun, F., Li, Y., Battestini, A., Setlur, V., and Mori, K., "Myngle: unifying and filtering web

content for unplanned access between multiple personal devices," in Proceedings of the 13th international conference on Ubiquitous computing (UbiComp '11), New York, NY, USA, 2011, pp. 257-266.

[5] Ham, D., Heo, J., Fossick, P., Wong, W., Park, S., Song C., and Bradley, M., "Conceptual framework and models for identifying and organizing usability impact factors of mobile phones" in Proceedings of the 18th Australia conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments (OZCHI '06), New York, NY, USA, 2006, pp. 261-268.

[6] Opera Mini & Opera Mobile browsers. (2013). Retrieved February 12, 2014, from <http://www.opera.com/mobile/>

[7] Sauro, J., and Kindlund, E., "A method to standardize usability metrics into a single score," in Proceedings of the SIGCHI conference on Human factors in computing systems (CHI '05), New York, NY, USA, 2005, pp. 401-409.

Real Time Employee Skills Tracking System

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Abstract

Any large company will probably have a large number of job applicants with various skill sets and amounts of experience. Thus, it would be beneficial to such an organization to have means to efficiently browse, organize, and maintain records of each applicant's relevant skills, experience, and contact information. In this work, we describe and demonstrate a software application to manage such records, written in C# using object-oriented design principles and techniques. An interface is used as an abstraction layer for the data storage mechanism, allowing the backend to be interchangeable (i.e., the applicant records can be stored in a local computer file, relational database table, etc.).

Key words: skills tracking system (STS), skills database

1. Introduction

An organization of any size will require people with varied skill sets in order to be successful. The idea of tracking information is not a new phenomenon as it was employed by the earlier scientist to track different things [1]. Today, organizations typically have many projects and operations, each of which calls for different combinations of abilities and experience [6]. For example, the employees of a software company have many different responsibilities. In addition to the developers of the actual software, a software company will need sales and customer support staff, accounting staff, and IT staff. Furthermore, the development team will need to do more than just write the software; the organization will also

require a public-facing website, internal software tools to aid development and support, and integrations and deployment solutions to get the product to the end users [5].

A large organization with many employees and job applicants would gain value from an efficient means to determine what skills are available within the organization and what skills are underrepresented or undeveloped, and to compare this information to the skills appropriate to both ongoing and future projects and tasks [3]. To this end, we have created a software application to manage records of the skills, experience, and contact information of employees and job applicants. This in-house software would allow the organization to save money from having to hire outside consultants for such service.

2. Overview and architecture

Unlike the work done in [2], where the use of Object oriented paradigm and techniques are not evident, our application uses the latest Object oriented programming techniques – making it scalable and real time. In particular, it provides an interface for a manager to maintain and search a database of employee and applicant records. We developed this software using object-oriented principles and techniques in order to achieve the benefits of modularity and extensibility. The software has four main components: the Resume class, which represents an employee or applicant record; the user interface; the Database class, which handles communication with the data store; and the data store itself, which can take any form, including a relational database such as MySQL, a flat text file, or a structured data file such as a SQLite database. The choice of these software was done with the customers in mind and with user-friendly appearance of the layout as a priority. Our demonstration used a SQLite database as the data store.

3. The Resume Object

A Resume object can store the following information about an employee or applicant:

- ☐ Full name
- ☐ A list of skills relevant to the employer
- ☐ Full address
- ☐ Email
- ☐ Home and cell phone numbers
- ☐ Date of birth
- ☐ Social Security number
- ☐ Level of education
- ☐ Degree field
- ☐ Position applied for
- ☐ Years of work experience, both in general and within the most relevant field
- ☐ Date resume was received
- ☐ Whether the subject has been interviewed

The user may query the database for resumes which matches any of these fields. Each resume can also store a text comment. If the underlying data store supports it, resumes may be retrieved based on keywords contained within the comments.

The user may optionally set an expiration date for any resume. On startup, the application checks for expired resumes and deletes them from the database.

A C# interface, named IDatabase, serves as an abstraction layer for the underlying data store. The details of how the application interacts with any given kind of data store must be contained within the code of a class which implements the IDatabase interface. Because the rest of the application code depends on the IDatabase interface, rather than a particular implementation of it, extending the application to use a different data store is very simple; the necessary changes are limited to the class which implements IDatabase. Furthermore, the search functionality of the application allows an

administrator with the appropriate credentials to search the database using any of the desired criteria as defined by the resume class. The Exit and the About menu on the main page allows the administrator or any other user to exit and read about the application, respectively.

4. Results and User Interface Screenshots

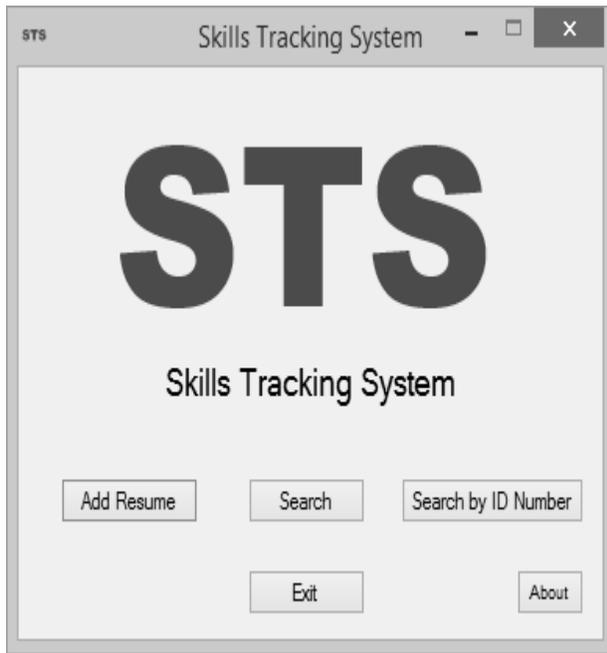


Figure 1: Main menu

Figure 2: New resume screen. Here the user may enter all of the data defined by the Resume class.

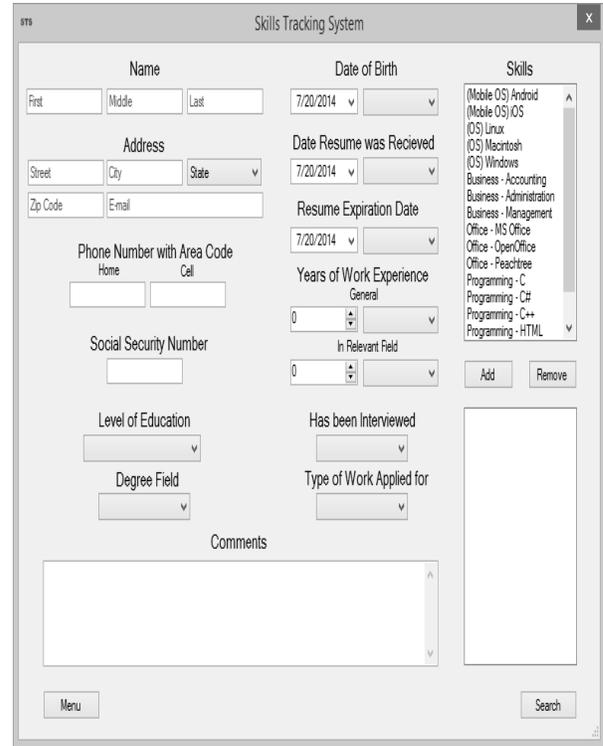


Figure 3: The same form shown in figure 2 also serves as the resume search screen. Every data field defined by the Resume class may be used in a search query.

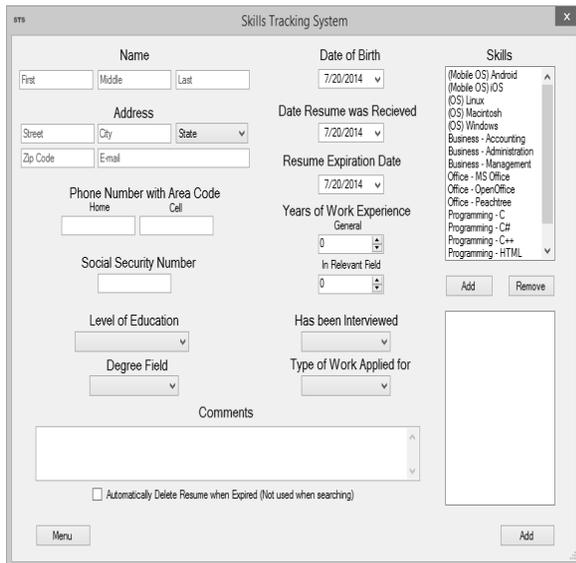


Figure 4: Search results screen. The update and view resume screens also

reuse the same form shown in figures 2 and 3.

4. Conclusion and future work

By allowing a user to easily and efficiently manage a large database of employee and applicant skills and contact information, this application can help any organization to find people with the skills it needs in order to be successful.

We plan to improve this work in several ways. Currently, our application only keeps track of information which is directly related to an employee or applicant. We intend to add the ability to define projects in terms of both their required and potentially applicable skills, as well as an artificial intelligence which can use this information to make suggestions on which people would be good matches to a project and who could be easily trained in the relevant skills. Finally, we intend to extend our application to allow employees to update their recorded skill sets directly through the application, rather than have to report such changes to a manager with access to the database. Optionally, these self-reported changes can be required to pass through manager verification before being applied to the skills database.

5. Reference

[1] Louis Liebenberg, "The Art of Tracking the Origin of Science," Available at <http://cybertracker.org/downloads/tracking/The-Art-of-Tracking-The-Origin-of-Science-Louis-Liebenberg.pdf>

[2] "Designing an Employee Training and Skills Tracking System." Available at <http://www.scribd.com/doc/7340360/Designing-an-Employee-Training-and-Skills-Tracking-System>

[3] Paul and Harvey Deitel, "Visual C# 2010 How to Program 4th Edition," Upper Saddle River, New Jersey. 2010.

[4] The Archive-Skills Consultancy "Tracking System: The Main Consideration," available at <http://www.archive-skills.com/infobytes/tracking.pdf>

[5] Brain Bench, "Report: Four Essential Components for Skills Inventory Management," available at http://www.brainbench.com/pdf/RPT_4EssComp.pdf

[6] Gary Woodhil and Piere Cahorn, "Tracking Competencies and Developing Skills Inventories with LearnFlex™," available at http://www.operitel.com/lib/pdf/wp_tracking_competencies.pdf

The Deformation Behavior of an Automotive Floor Panel During Sheet Hydroforming onto Male/Female Die Halves

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Abstract

Modeling sheet hydroforming processes was building momentum recently due to increasing importance of the process in auto and aerospace industry. Two main techniques are used in the process, these are, male and female die sets. This work investigates the deformation behavior of an automotive floor panel during sheet hydroforming in case of using a male and female die sets. Reverse engineering was used to build a solid model of an automobile floor panel. An optimum blank size and shape is determined and the hydroforming die setup model was built. The model was tested using FEM simulation for both cases using the same process variables, and the results are compared to manifest the advantages and disadvantages of both processes.

Introduction

Sheet hydroforming (SHF) process draws greater attention in automotive and aerospace industries due to its advantages as higher strength to weight ratio, weight reduction, improved quality, tighter tolerances and reduced tooling cost. The process also allows the manufacturing of parts with very complicated geometries that would be very difficult and costly to manufacture using traditional techniques [1-4]. SHF is also getting more attention due to its ability to shape light weight materials such as aluminum and magnesium (warm or cold) easier and less costly than stamping [3, 5].

Two main techniques are used to process sheet metal hydroforming. These are: sheet metal hydroforming using die (SHY-D) where the intended product shape is formed on the die surface, and sheet metal hydroforming using punch where the intended product shape is formed on the

punch surface. In the first case the die is considered as male, while in the second case, the die is considered as female.

In SHY-D, the sheet is deformed against die inner surface by pressurized oil. In SHY-P, the sheet is deformed against the punch outer surface due to the punch movement inside a die full of pressurized oil. In this paper numerical simulation is used to compare between the two techniques with respect to several issues including: thinning, displacements, stresses and required machine tonnage.

Numerical Simulation

Numerical simulation in this paper was conducted using DYNAFORM version 5.9. DYNAFORM is well established simulation software in the area of sheet metal working including sheet hydroforming (SHF). The software consists of several modules to increase its capabilities and flexibility. DYNAFORM modules use Finite Element

Analysis (FEA) to simulate sheet forming processes.

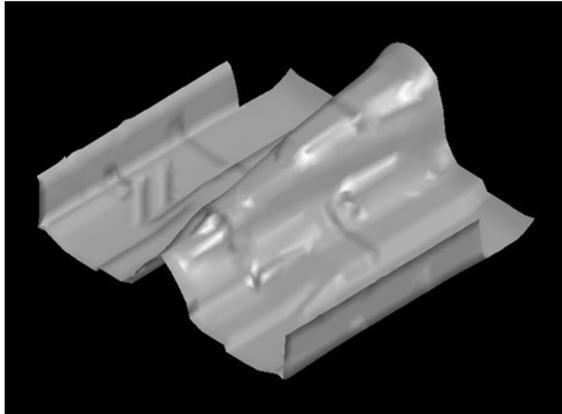


Figure 1: Floor panel part

To fulfill the goal of this paper, a complicated part that is used as a floor panel in a sedan automobile was selected as shown in Figure 1. Reverse engineering techniques were used to model the part. The initial blank geometry was optimized using Blank Size Engineering (BSE) module in DYNAFORM [6]. The module uses a solver called “MSTEP” to perform both blank size estimate and quick formability analysis. MSTEP depends on a Finite Element Inverse Approach to predict the initial blank shape. Figure 2 shows the predicted initial blank geometry. The sheet initial thickness was 4mm.

Two models were built using

DYNAFORM to produce the selected part. The first model represents the female die setup (SHF with a punch, SHF-P), while the second model represents the male die setup (SHF with a die, SHF-D). Figure 3 shows the two models.

The sheet material was selected as DQSK (Drawing Quality Special Killed) steel. Figure 4 shows the stress-strain curve for this material. This type of steel is developed specially for drawing processes. It possess higher ductility and better uniformity of

properties compared to available

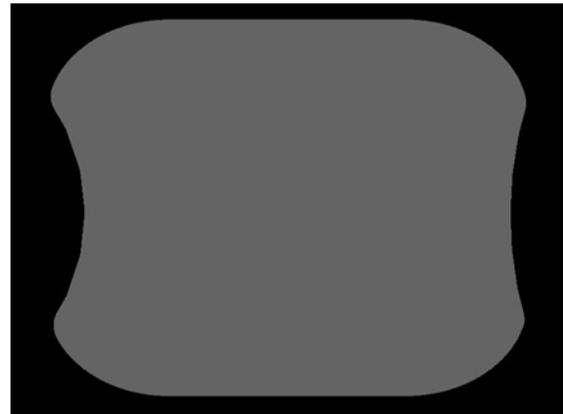


Figure 2: Initial sheet geometry

commercial steels. The oil pressure during the process follows the curve shown in Figure 5.

The model components were built using Belytschko-Lin-Tsay shell elements. The contact between components was defined as `contact_forming_one_way_surface_to_surface`. The timing was selected as 0.5 seconds for closing the die and 0.1 seconds for the drawing process. All parameters were identical in both cases.

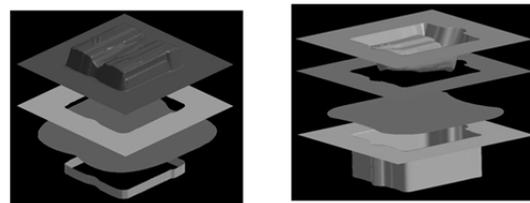


Figure 3: Simulation models: SHF-D (a) and SHF-P (b)

Figure 3 Simulation models SHF-D (a) and SHF-P (b)

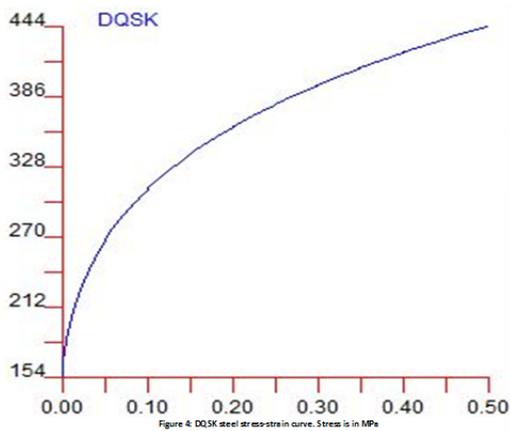


Figure 4: DQSK steel stress-strain curve. Stress is in MPa

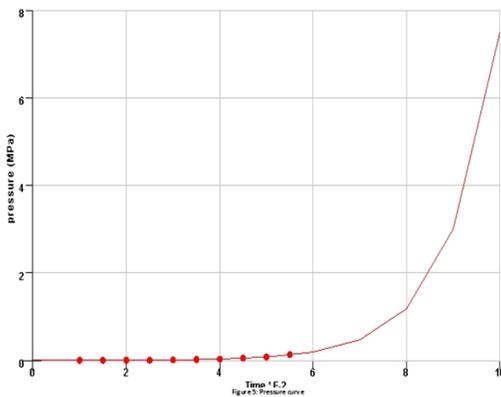


Figure 5: Pressure Curve

Results and Comparison

Figure 6 shows the blank sheet displacement in the z-direction during the drawing process in both cases. The maximum displacements in SHF-D and SHF-P were 425 and 471 mm respectively.

Figure 6: Displacement in z-direction. SHF-D (a) and SHF-P (b)

Figure 7 shows the edge movement in x-y plane. Significant difference was noticed between both cases. The maximum edge movements in SHF-D and SHF-P were 308 and 168 mm respectively. Figure 8 shows the thickness of the sheet at the end of drawing process. As mentioned earlier, the initial sheet thickness was 4 mm. The

resulted minimum thickness in SHF-D and SHF-P was 2.55 and 2.1 mm respectively. The simulation model showed no differences in resulted Von-misses stresses in both cases with maximum Von-Mises stress to be 500 MPa as shown in Figure 9. The predicted machine tonnage required for the SHF-D was about 5000 tons, while that of SHF-P was 2800 tons.

Conclusions

A simulation model was built using DYNAFORM to compare between sheet hydroforming using die and sheet hydroforming using punch. The model simulated the process of shaping a complicated part used as floor panel in an automobile to achieve the comparison.

The results showed that the main differences between the two cases were in sheet edge movement, sheet thinning and predicted required machine tonnage. The maximum Von-Mises stress and displacement in z-direction did not show significant differences.

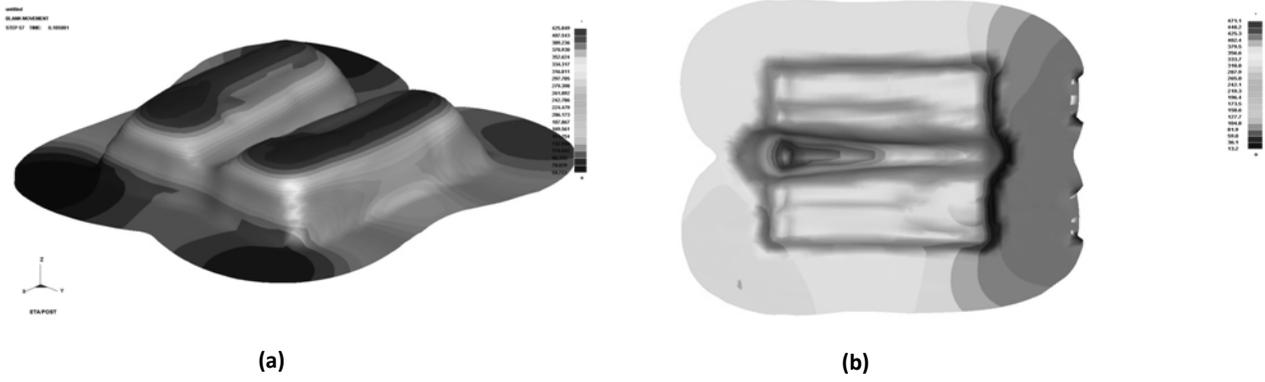


Figure 6: Displacement in z-direction. SHF-D (a) and SHF-P (b)

Figure 7: Edge displacement in x-y plane.
SHF-D (a) and SHF-P (b)

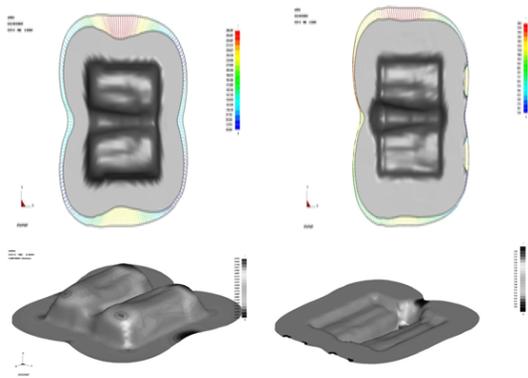


Figure 8: Sheet thickness at the end of drawing process. SHF-D (a) and SHF-P (b)

References

A. Del Prete, G. Papadia, A.A. De Vitis and T. Primo, "Finite Element Simulations for Sheet Warm Hydroforming", The 14th International ESAFORM Conference on Material Forming, AIP Conf. Proc. 1353, 313-318 (2011).

A. KOCANDA and H. SADLOWSKA, "Automotive component development by means of hydroforming: a review", ARCHIVES OF CIVIL AND MECHANICAL ENGINEERING Vol. VIII, No.3, 2008.

Li X Zhou, Shi H Zhang, Ben X Wang, "Research on the Effects of the Movable Die and its Counter Force on Sheet Hydroforming", AIP Conf. Proc. 908, 817 (2007).

Nader Abedrabbo, Farhang Pourboghraat and John Carsley, "Sheet hydroforming Simulation of a License-Plate-Pocket Panel", AIP Conference Proceedings, Volume 712, pp. 1166-1171 (2004).

Manan Shah, Eren Billur, Partchapol Sartkulvanich, John Carsley and Taylan Altan, "Cold and Warm Hydroforming of AA754-O Sheet:FE Simulations and Experiments", The 8th International Conference and Workshop on Numerical Simulation of 3D Sheet Metal Forming Processes, AIP Conf. Proc. 1383, 690-697 (2011).

ETA DYNAFORM BSE training manual, September, 2006

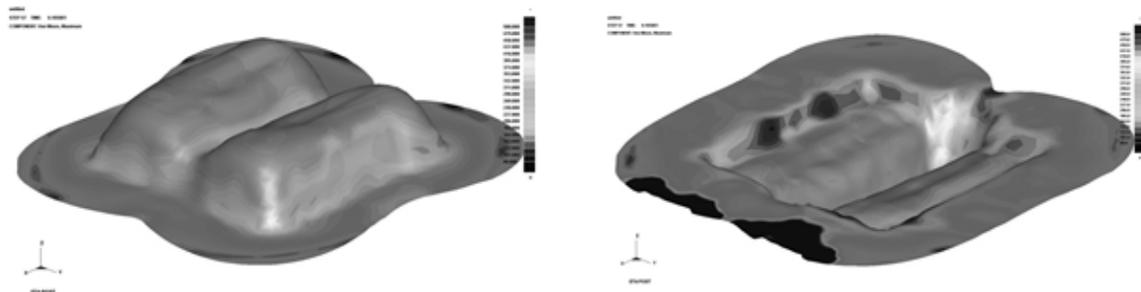


Figure 9: Von-Mises stress. SHF-D (a) and SHF-P (b)

The Financial Advantage of Certification of an Effective Environmental Management System: An Analysis of International Companies Adopting ISO 14001

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Abstract

This exploratory study looks at the financial characteristics of internationally-based companies who adopt ISO 14001, as compared to a group of non-adopter competitors. Financial data from Mergent Online is analyzed for a group of manufacturing ISO 14001 adopters obtained from the Directory of ISO 14001 Companies with operations in Hong Kong and/or traded on the Hong Kong stock market as of June 2013.

1. Introduction

ISO 14001 applies to any organization that wants to establish, implement, maintain and improve an environmental management system and ensure that it conforms with the company's stated environmental policy. It is probably the world's most recognized environmental management standard in assisting companies achieve sustainable success. Implemented effectively, ISO 14001 can help organizations meet legal obligations, increase business opportunities, and also reduce waste and costs.

In order to implement ISO 14001 successfully, BSI, a business standards company, urges its clients to follow ten key tips, which include:

1. Gaining commitment and support from senior management.
2. Engaging the whole business with good internal communication.
3. Comparing the company's existing quality systems with ISO 14001 requirements.
4. Obtaining customer and supplier feedback on current environmental management.
5. Establishing an implementation team to get the best results.
6. Mapping out and sharing roles, responsibilities, and timescales.
7. Adapting the basic principles of environmental management to your business.
8. Motivating staff involvement with training and incentives.
9. Sharing ISO 14001 knowledge and encouraging staff to train as internal auditors.
10. Regularly reviewing the ISO 14001 system to ensure continual improvement (BSI staff, 2014a).

In the manufacturing industry, software solutions designed to meet these international standards are critical for helping firms deliver products to market on-time with transparency, assure real-time reporting, improve quality, achieve compliance assurance, and protect brand reputation by reducing the risk of recalls.

For multinational organizations with various facilities, such as technical and engineering centers and logistics locations, ISO 14001

certification is a stamp of approval indicating that the company maintains and upholds high performance standards, regardless of

geographical locations or social and economic conditions in the country.

2.1 Data: The Relationship between ISO 14001 certification versus profitability and productivity

This exploratory research compares companies that have ISO certification 14001 to their competitors, who do not. Financial data from Mergent Online was analyzed for a group of 40 manufacturers of consumer food, clothing, and durables with ISO 14001 certification obtained from the Directory of ISO 14001 Companies (total 867) with operations in Hong Kong as of June 2013 (EPD, 2014). The ISO 14001 certified companies were compared with non-ISO 14001 certified competitors to examine the relationship between environmental disclosure in corporate annual reports and corporate financial position and profitability, using a set of six analytical measures.

According to the ISO (2014), the potential benefits of using ISO 14001, in addition to the environmental benefits, can include the achievement of higher profitability and productivity. Implementing an environmental management system based on ISO 14001 allows companies to not only reduce costs related to waste management, energy consumption, materials, and distribution, but also increase revenue through an improved brand image among its stakeholders. In addition, ISO (2014) emphasizes that ISO 14001 as a fact of being an International Standard allows companies to access new markets and thus to increase market share.

Non-ISO international competitor

companies of similar size (obtained from the Mergent competitor listing) were compared with ISO 14001 certified companies by considering market share in terms of revenue followed by total assets and number of employees. To compare profitability and productivity between these two groups of companies, the ratios shown in Table 1 were selected.

Table 1: Profitability and Productivity Measures Analyzed

| RATIOS | JUSTIFICATION |
|-----------------------------------|---|
| Profitability | |
| Gross Margin (%) | The gross margin percentage measures a firm’s ability to generate profit from its primary activities, and is therefore considered to be an essential ratio to measure profitability on a primary basis. |
| Profit Margin (%) | The profit margin percentage represents the percentage of sales that a company retains in actual earnings. Consequently, it is a critical measure for overall profitability. |
| Productivity | |
| Receivables Turnover | The receivables turnover ratio focuses on a firm’s efficiency in collecting debts, and is appropriate to use when measuring the productivity of manufacturing firms. |
| Inventory Turnover | Similar to the receivables turnover, the inventory turnover ratio demonstrates how many times a firm replaces its inventory over a certain period and is also a good measure of efficiency. |
| Profitability/Productivity | |
| Return on Assets (%) | Return on Assets (ROA) not only measures how efficiently management is using total assets in order to generate profit, but is a good complementary |

| | |
|----------------------|---|
| | ratio for measuring both profitability and productivity in terms of management's effectiveness. |
| Return on Equity (%) | Return on Equity (ROE) measures the proportion of stockholders' equity that is turned into profit and similar to ROA is a valuable complementary ratio for measuring profitability and productivity in terms of management effectiveness. |

2.2. Hypothesis

A two-sample t-test was performed for each of these six measures using the analytic measures for both the ISO 14001 certified companies and their non-ISO competitors within the consumer food, clothing, and durables manufacturing sector. This analysis will help determine if ISO 14001 certified companies are more profitable and productive than non-ISO certified companies within this particular manufacturing sector on the Hong Kong stock market exchange. Consequently, the following hypotheses are formulated:

- H_0 : ISO 14001 certified companies *are not* more profitable and productive than non-ISO certified companies within the consumer food, clothing, and durables manufacturing sector.
- H_1 : ISO 14001 certified companies *are* more profitable and productive than non-ISO certified companies within the consumer food, clothing, and durables manufacturing sector.

2.3 Assumptions

As part of this study, there are implicit assumptions that the sample of the ISO certified companies are representative of the population of international consumer food, clothing, and durables manufacturing companies; secondly, there is an assumption that the justification methodology used to select the non-ISO companies is appropriate for assuring that these companies are actual competitors to the ISO

certified companies and that the selected analytical measures are representative of profitability and productivity evaluation.

3.0 Results

Table 2 presents the results of the two-sample t-test for each analytical measurement.

In order to reject the null hypothesis at a specified probability, the calculated value of t must be greater than the critical value.

Table 2: Results of Two-sample T-test

| RATIO | t-Stat | t-Critical Value one-tail | P-value one-tail | Mean ISO | Mean Non-ISO |
|-----------------------------------|--------|---------------------------|------------------|----------|--------------|
| Profitability | | | | | |
| Gross Margin | 0.4798 | 1.6646 | 0.316 | 25.854 | 24.219 |
| Profit Margin | 1.1906 | 1.6646 | 0.119 | 7.3865 | 2.1233 |
| Productivity | | | | | |
| Rec. Turn-over | -2.486 | 1.6646 | 0.008 | 6.684 | 12.555 |
| Inv. Turn-over | 0.0549 | 1.6646 | 0.478 | 8.7428 | 8.6225 |
| Profitability/Productivity | | | | | |
| ROA | 0.1380 | 1.6646 | 0.445 | 3.1245 | 2.7433 |
| ROE | 1.1906 | 1.6646 | 0.119 | 7.3865 | 2.1233 |

3.1 Analysis

3.1.1 Profitability Measures

Gross Margin Percentage: Since t-stat is smaller than t-critical, no statistical significance exists between ISO 14001 certified companies being more profitable in terms of gross margin than non-ISO certified companies within the consumer food, clothing, and durables

manufacturing sector. This is also demonstrated by the high P-value, which indicates the chance of rejecting a true H_0 : is 31.2%.

Profit Margin Percentage: With respect to profitability demonstrated by the profit margin percentage, t-stat is smaller than t-critical, indicating that no statistical significance exists between that ISO 14001 certified companies and

non-ISO certified companies within the consumer food, clothing, and durables manufacturing sector. This is also demonstrated by the high P-value, which reveals that the chance of incorrectly rejecting the null hypothesis is as large as 11.9%.

3.1.2 Productivity Measures

Receivables Turnover: In this analysis, the t-stat -2.49 is greater than the absolute critical value for t. In terms of value, this provides statistically significant evidence that ISO 14001 certified companies show a lower accounts receivable turnover for manufactured goods than non-ISO certified companies within the consumer food, clothing, and durables manufacturing sector. This could be due to multiple causes and should be further explored.

Inventory Turnover: For this measure, t-stat is smaller than t-critical which suggests that ISO 14001 certified companies are not more productive in terms of inventory turnover than non-ISO certified companies within the consumer food, clothing, and durables manufacturing sector. The high P-value indicates that the observed difference is expected to occur about one-half of the time if the null hypothesis is true.

3.1.3 Profitability/Productivity Measures

Return on Assets (ROA): For ROA, t-stat is smaller than t-critical, which communicates that there is no statistical significant between the two samples as far as better generation of profits based on the usage of total assets. Likewise, the P-value, which expresses that the chance of incorrectly rejecting the null hypothesis is as large as 44.5%.

Return on Equity (ROE): In the analysis of ROE, t-stat is smaller than t-critical, pointing out that the generation of a return on equity is not statistically significant for ISO 14001 certified companies as compared to non-ISO certified companies within the consumer food, clothing, and durables manufacturing sector. The chance of rejecting a true null hypothesis is 26.3%.

4. Future Research

While this study presents little to no evidence of differing profitability/productivity between 14001 and non-14001 company's ratios, the author acknowledges that a more comprehensive study of industries from in the Hong Kong data source, a different choice of ratios, or a more sophisticated statistical design may have been more demonstrative of possible differences. In addition, the author recognizes that the study considers only the most current single year available for all firms (fiscal 2013). Perhaps a longitudinal study would be more revealing. Likewise, exploring a paired t-test of the same companies before certification and after certification might demonstrate significant differences in profitability and productivity.

The one statistically significant productivity measure – receivables turnover – needs to be explored further to see if this could be a result of economic conditions, failure to properly integrate treasury functions with supply chain configurations or sustainability processes, charitable write-offs to a local economy or to local area disaster victims, private label contracts to distressed customers, or disruptions and/or penalties in the delivery of contracted goods.

5. Conclusion

In conclusion, it will be interesting to update and revise this study again in future years after the ISO 14001 standard revision, which is expected to be available in early 2015. The revision is anticipated to provide further integration and fewer differences between companies when implementing more than one management system. Additionally, the revision will focus on increased communication with external/internal stakeholders when implementing ISO 14001, particularly within smaller organizations (BSI staff, 2014b).

6. References

BSI staff (2014a). Implementing ISO 14001 Environmental Management. BSI Website. (Retrievable at <http://www.bsigroup.com/en-US/ISO-14001-Environmental-Management/Implementing-ISO-14001/>)

BSI staff (2014b). ISO 14001 Revision is Underway. BSI Website (Retrievable at <http://www.bsigroup.com/en-GB/iso-14001-environmental-management/ISO-14001-revision/>)

Environmental Protection Department (EPD) – Hong Kong. (2014). Environmental Management Tools - Directory. EDP website (Retrievable online at http://www.epd.gov.hk/epd/english/how_help/tools_ems/iso14001.html)

International Standards Organization. (2014). *ISO 14000 - Environmental Management*. Iso.org. (Retrievable online at <http://www.iso.org/iso/iso14000>)

The Evaluation of Route Definition Software

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Abstract

One of the most important issues for a service provider is that of minimizing the cost of providing the service. This is especially true when the service provided involves visiting the customer to provide the service. In such a service as this, it is necessary that the costs to design routes for visiting the customers are calculated in such a way as to minimize the route costs. In this paper, we evaluate several software packages for solving the routing problem, and recommend one based upon specific criteria.

1. Introduction

Service companies that provide various services through delivery methods want to focus on minimizing costs through scheduling efficient routes. A certain company contacted Florida A&M University's Supply Chain II class with Dr. J.S. Sutterfield. The research problem given to the students was to find a method or possible solution to optimize vehicle routes for drivers daily, weekly, and monthly schedules.

The issues occurring within the company's current methods were assigning routes and service times for specific clients. The task given to the students was to develop a solution(s) to assist the company in assigning optimized routes. Route optimization was essential for the service provider, because such routing enables the drivers to deliver the highest quality of service to customers at the least possible cost, viz. it minimizes such costs as fuel, overtime pay, operation and maintenance, etc.

Thus, the routing software needed to be capable of assigning routes in the most cost-efficient manner, and to be

flexible so as to permit adding or eliminating routes and/or changes in clients or client locations.

This paper will discuss the solution(s) found for the service company for creating the most efficient routes and minimizing costs as well. The focus was on route optimization more so than minimizing costs for the research discussed later in the paper.

2. Literature Review

Ghani, Guerriero, Laporte, and Musmanno (2003) discusses vehicle routing problems (VRPs) as being central to logistics management in both private and public sectors. Most common operational constraints impose that the total demand carried by a vehicle at any time does not exceed a given capacity, the total duration of any route is not greater than a prescribed bound, and service time windows set by customers are respected. Within this particular journal article, the researchers developed a concept on how to quantify designing a real-time routing algorithm. Lund et al. (1996) defines the degree of dynamism as,

$$\delta = \frac{n_d}{n_s + n_d}$$

where n_s and n_d are the number of static and dynamic requests, respectively. Moreover, let

$$t_i \in [0, T]$$

be the occurrence time of service request i . Static requests are such that $t_i = 0$ while dynamic ones have

$$t_i \in (0, T].$$

This may vary between 0 and 1. Its meaning is straightforward. For instance, if δ is equal to 0.3, then 3 customers out of 10 are dynamic. Later, Larsen (1999) extends the definition the dynamic problem proposed by Lund which takes possible time windows into account.

$$\delta' = \frac{\sum_{i=1}^{n_s + n_d} t_i / T}{n_s + n_d}$$

where δ' ranges from 0 and 1. It is equal to 0 if all user requests are known in advance while it is equal to 1 if all user requests occur at time T . Finally, Larson (1999) comes to the final concept taking window service times and immediate requests into account. Let a_i and b_i be the ready time and deadline of client i

$$(t_i \in [a_i, b_i]),$$

respectively.

$$\delta'' = \frac{\sum_{i=1}^{n_s + n_d} [T - (b_i - t_i)] / T}{n_s + n_d}$$

It can be shown that δ'' also varies between 0 and 1. Moreover, if no time windows are imposed (i.e., $a_i = t_i$ and $b_i = T$), then $\delta'' = \delta'$. As a rule, vendor-based distribution systems, such as those distributing heating oil, are weakly dynamic.

Ichoua et al. (2007) discusses the difficulty in dynamic vehicle routing. The concern which has been universal in the research falls with the uncertainty that comes from the occurrence of new requests. Different approaches are considered within this article and investigated. Various factors are considered like consolidation of multiple requests into the same vehicle may be allowed and addressed through the design of planned routes. The different approaches were the pure myopic approach, and then, the issues of diversion and anticipation of future requests and other issues were discussed.

Zhao and Zeng define a solution for optimizing a transit route network, vehicle headways, and timetables for large-scale transit networks. There seems to be a lack of effective and systematic optimization of a wide range of procedures for the simultaneous design of routing networks, vehicle frequencies, and timetables for large-scale TN problems of realistic sizes (Zhao and Zeng, 2008). In this work, the proposed mathematical optimization process was formulated as

$$\text{Minimize: } u_{\text{cost}}(T, h, S, O) \quad \forall T \in \underline{T}, h \in \underline{H} \text{ and } S \in \underline{S}$$

subject to:

Route headway, route length, and total TN vehicle fleet size constraints :

$$h_{\min}^{(q)} \leq h_q \leq h_{\max}^{(q)}, l_{\min}^{(q)} \leq l_q \leq l_{\max}^{(q)} \quad (q = 1, 2, \dots, T) \quad \text{and} \quad \sum_{q=1}^T v_q \leq v_{\max},$$

Route load factor constraints: $L_q \leq L_{\max}^{(q)} \quad (q = 1, 2, \dots, T),$

Ghiani et al. (2003) discusses how technological advances with information and communication have assisted with managing vehicle fleets in real time. Fu (2001) examined the adaptive routing problem in traffic networks in which link

travel times are modeled as random variables with known mean and standard deviation, and their realizations can be estimated based on real-time information collected over the links.

3. Methodology

In **Figure 1** below, a typical example of one scenario is shown.

Figure 1: Typical routing scenario

The original method used to attack this problem was the hand calculated method. This method was set up where the clients, addresses, and time windows were entered in Excel, and the routes were mapped out by distance. This method, however was quickly abandoned because of the immense complexity of optimizing the routings manually.

The second method considered was building a program within Excel through a formulating a mathematical model to optimize the routes assigned to drivers. This model would have used the information in the service providers dataset as input for the model. However, with upward of 100 routes on one vehicle schedule, it soon became obvious that the problem at hand was far too large and complex for such an approach.

The research eventually turned to computer-generated software that offered optimization features along with side components like minimizing costs i.e. gas, mileage, and window time constraints. The remaining research focused upon evaluating models specifically designed to solve such problems.

4. Application of Methodology

Several programs were found to be available commercially for solving and managing the rout optimization problem. Each program was applied to the routing scenario shown in **Figure 1**. These programs were then compared as to their efficiency and flexibility in permitting routings to be optimized.

The first program to this routing scenario was **AceRoute**, a Google-based application. This program is free of charge to small business users with a Google or Yahoo account. However, prices are assessed to larger companies depending upon usage. **AceRoute** had sufficient capacity for uploading a maximum 2,500 addresses in files of 100 via CSV or QuickBooks, and offered free features with premium services availability. Once the Excel spreadsheet was uploaded into **AceRoute**, it permitted the routings to be automatically optimized. An AceRoute output using the **Figure 1** typical routing scenario is shown in **Figure 2**.

The next program studied was **Viamente** Route Planner. Although only a limited implementation was available for a trial period, the operational process seemed very efficient. The initial Viamente panel is shown in Figure 3.

Figure 3: Initial Viamente panel

Similar to the previous program, **Viamente** allowed the Excel spreadsheet to be uploaded and ran the optimization. However, it took it a step further and offered the estimated cost of gas usage in

dollars. It also cut off list of service orders given the specified constraint for the 8-hour day. The version of **Viamente** investigated was a basic, trial version, but this software can be customized to the requirements of the user upon request with a corresponding price increase depending upon the features desired. The output from the **Viamente** software is shown in **Figure 4**.

Figure 4: Viamente output

In **Figure 4**, **Viamente** was shown with the example of orders and drivers routes given. The color coding represents different drivers and their given routes. This program specifies the most efficient route schedule.

Some of the features with this software include a planning horizon of up to 30 days, rescheduling work orders in real time, and mobile accessibility to name a few.

When addressing the concerns past researchers have ran into, the adding or changing of orders can easily be uploaded into the software and the re-optimized at any given point. This method was considered the most useful and efficient for the problem of route scheduling.

Two other software offerings were investigated for the customer's application, but neither was found to be as satisfactory as the two described above. A comparative table is shown in **Table 1**.

Table 1: Comparison of software examined

6. Conclusions

In conclusion, the software method for schedule vehicle routes has proven to be the best solution. While price becomes a factor, the amount of funds the company will save offsets the expense. Researchers have been mind-boggled with this problem and the software metrics have proven to be a success.

There are even more route planner software offerings available for service companies. Each company focuses on different needs to accomplish route optimization. These companies have to evaluate the different benefits and offerings and choose the best option.

Finally, as shown in Table 1, several companies were researched as to the features available in their routing optimization software. The offering thought to be most adaptable to the customer's requirements was that offered by **Viamente**.

References

Ichoua, S., Gendreau, M., & Potvin, J. Y. (2007). Planned route optimization for real-time vehicle routing. In *Dynamic Fleet Management* (pp. 1-18). Springer US.

Ghani, G., Guerriero, F., Laporte, G., & Musmanno, R. (2003). Real-time vehicle routing: Solution concepts, algorithms and parallel computing strategies. *European Journal of Operational Research*, 151(1), 1-11.

Zhao, F., & Zeng, X. (2008). Optimization of transit route network, vehicle headways and timetables for large-scale transit networks. *European Journal of Operational Research*, 186(2), 841-855.

Ghiani, G., Guerriero, F., Laporte, G., & Musmanno, R. (2003). Real-time vehicle routing: Solution concepts, algorithms and parallel computing strategies. *European Journal of Operational Research*, 151(1), 1-11.

Fu, L. (2001). An adaptive routing algorithm for in-vehicle route guidance systems with real-time information. *Transportation Research Part B: Methodological*, 35(8), 749-765.

Bräysy, O., Hasle, G., & Dullaert, W. (2004). A multi-start local search algorithm for the vehicle routing problem with time windows. *European Journal of Operational Research*, 159(3), 586-605.

Metea, M., & Tsai, J. (1987, March). Route planning for intelligent autonomous land vehicles using hierarchical terrain representation. In *Robotics and Automation. Proceedings. 1987 IEEE International Conference on* (Vol. 4, pp. 1947-1952). IEEE.

Koskosidis, Y. A., Powell, W. B., & Solomon, M. M. (1992). An optimization-based heuristic for vehicle routing and scheduling with soft time window constraints. *Transportation Science*, 26(2), 69-85.

Schuessler, R. (1998). *U.S. Patent No. 5,818,356*. Washington, DC: U.S. Patent and Trademark Office.

Wang, C. H., & Lu, J. Z. (2009). A hybrid genetic algorithm that optimizes capacitated vehicle routing problems. *Expert Systems with Applications*, 36(2), 2921-2936.

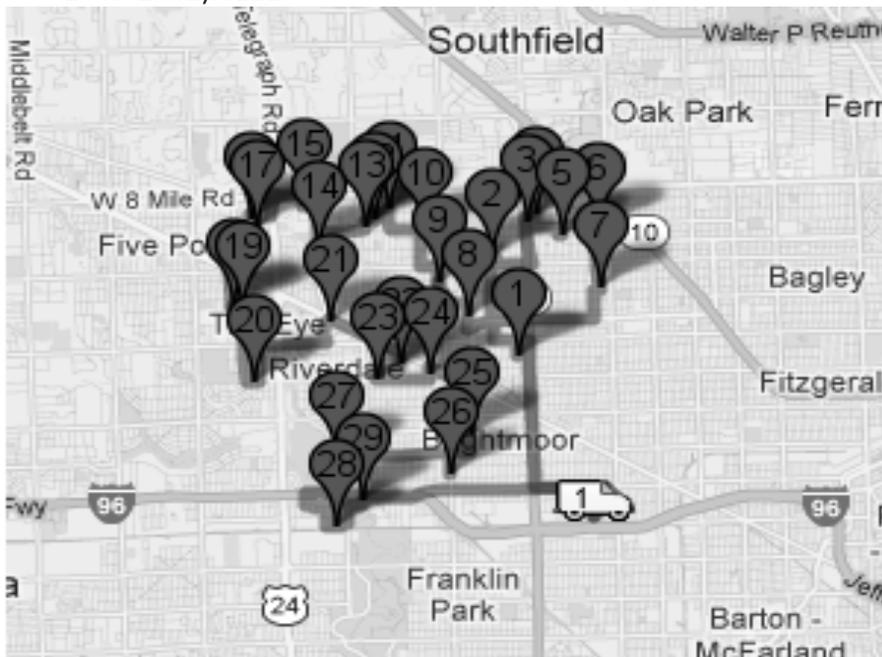


Figure 1: Typical routing scenario

Figure 2: AceRoute output for typical scenario

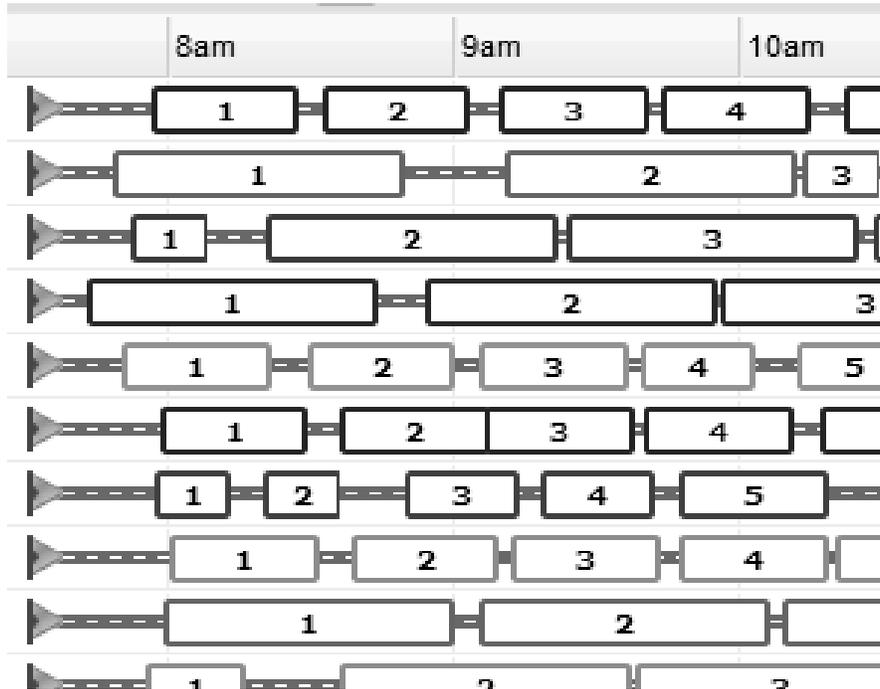


Figure 3: Initial Viamente panel

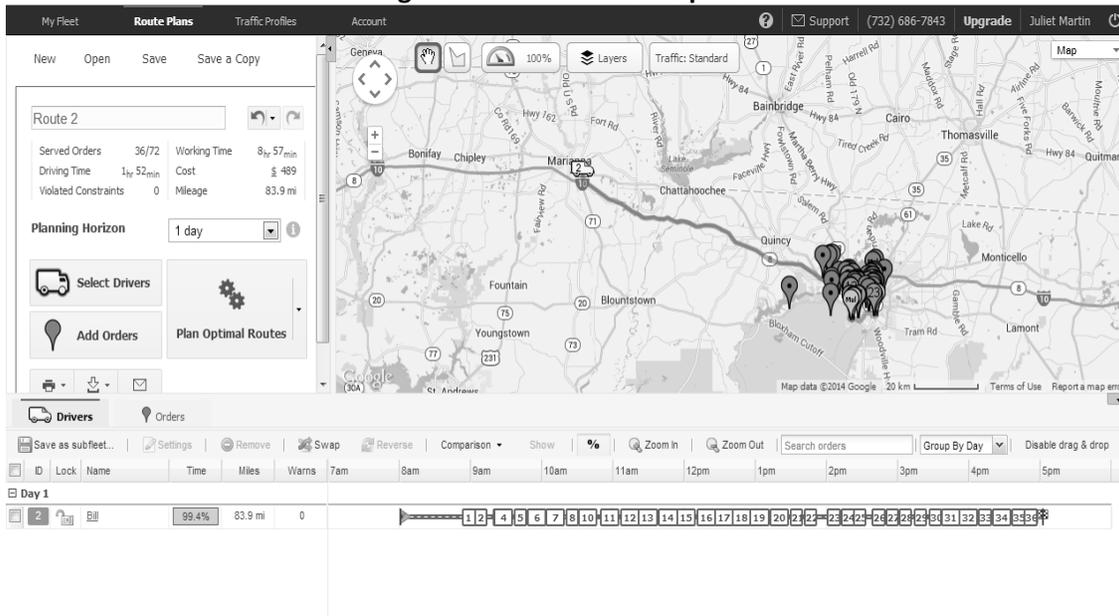


Figure 4: Viamente output



Table 1: Comparison of software examined

| Program | Cost (Annual rates) | Features | Customer Service Assistance |
|-------------|---|---|---|
| Aceroute | Free for small businesses (For Google and Yahoo accounts) | √ includes route optimization | Yes |
| Viamente | Quote on request for larger businesses | √ includes route optimization | Yes |
| TMW Systems | Undisclosed | √ includes multiple optimization features | Yes – contact necessary for access to program |
| FleetRoute | Undisclosed | √ includes optimization feature | Yes – contact necessary for access to program |

Using Quality Function to Design a Business Curriculum: Phase I

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Abstract

Quality Function Deployment (QFD) is a well established method in the design engineering field for both the advanced design of new products, as well as the redesign of existing products. Although it is a very general approach to such design, it has not been widely used in other disciplines. In this paper we demonstrate its use in the design of a curriculum for a Business school.

1. INTRODUCTION

Quality Function Deployment (QFD) is a structured methodology for developing a set of customer features for a new product offering. As such, it is said to provide "the voice of the customer" to new product designs. The methodology was devised about 1966 by a Dr. Yoji Akao, a Japanese planning specialist (Akao, 1994). In the early 1970s it was used in shipbuilding by Mitsubishi and Kobe, a Japanese supertanker company. Since that time, it has been used extensively to improve profits at the Toyota Automobile Corp. QFD is an integrated product development approach in which customer preferences are translated into product features. QFD helps multi-functional teams identify and prioritize customer requirements and relate these needs to corresponding product or service characteristics.

The basis of QFD methodology is the "fishbone" or Ishikawa diagram, which was devised by the Japanese professor and quality engineer, Dr. Kaoru Ishikawa. Although the basic concept dates back to the 1920s, it is Dr. Ishikawa who popularized its use in the quality

movement. Since that time, it has become one of the seven basic tools of quality management (Tague, 2004). The power of the Ishikawa diagram consists in its capacity to take large numbers of disparate customer requirements and to array them in a cohesive, coherent structure. It provides the first stage in translating qualitative ideas, or the voice of the customer, into quantitative information that can be analyzed and manipulated to develop the required product. An example of an Ishikawa or Fishbone Diagram is shown in Figure 1 (Sule, 1998).

Figure 1: Example Ishikawa Diagram

The purpose of this step is to take an abstract idea, and "clothe" it with product requirements. This is done by answering the questions "what," "when," "where," "why," and "how." Once the product requirements have been developed, they are transferred into a QFD Chart, or more generally in the first stage of houses of quality (HoQ). The QFD Chart, or first HoQ relates the customer requirements to the product attributes or features necessary to satisfy them. A typical two-stage HoQ sequence is shown in Figure 2.

Figure 2: Houses of quality

The HoQs shown above are typical of what might be used to qualify and choose a supplier from several potential suppliers to provide some product. The weighted scores are employed to indicate the relative importance of the supplier attributes, as well the relative degree to which each supplier satisfies the attributes. For some applications, the house rooves are used to obtain additional information as to how the attributes of a product. However, depending upon the application, these do not always have meaning. These HoQs may be extended indefinitely, as might be required for any particular application. The approach used in this paper will be to use a two-phased QFD approach to develop a business curriculum. This paper will present the first phase of this project in which a set of skills and knowledge recommended by the National Business council is related to a set of personal abilities desired by corporations. The second phase will translate these skills into a business curriculum.

2. LITERATURE SEARCH

QFD has been a central feature in implementing Total Quality Management (TQM) projects (Summers, 2005). Over the years, QFD has attracted attention from a wide range of industrial organizations in the US including Ford Motor Company, General Motors, Rockwell International, AT&T, DEC, Hewlett-Packard, and Polaroid (Schubert, 1989). Although most of the reported applications have been in the area of product development and improvement, QFD also has been successfully applied as a strategic planning tool for service improvement projects (Maddux, et al, 1991). As a matter of fact, QFD is such a

generalized approach that it can be used for new product developments (Akao, 1990, 1994) and for process improvement projects (Benjamin, et al, 1996).

QFD is extremely flexible as has been demonstrated by its use as an integrated framework to facilitate planning in such areas as technology transfer on information technology projects (Khawaja and Benjamin, 1996), business planning in small companies (Ferrell and Ferrell, 1994), and manufacturing strategic planning (Crowe and Cheng, 1996). The HOQ approach may be adapted to any number of phases. Benjamin, et al (1998), have even modified the QFD approach for use in academic course planning. Although used for several curriculum related projects, it does not appear to have been used to plan an entire business curriculum.

3. METHODOLOGY

To begin the QFD process for the design of a product, whether tangible or intangible, a team of individuals is usually convened. These individuals are selected from widely differing backgrounds, because the interaction of such people has been found to facilitate the QFD process, and to produce the best results. These individuals develop the features of the product by extensively exploring and answering the questions “where,” “what,” “when,” “why” and “how.” This is done by using an Ishikawa or “fishbone” diagram such as the one shown above in Figure 1. Once it is believed that this process has produced all of the results possible, the second stage of the process is undertaken.

This second stage of the QFD process takes the product features developed in the first stage and assigns

them an importance rating on a scale of 9 thru 1: The greater the rating, the more important the feature, and vice-versa. These features, now ordered in importance from greatest to least, are arranged into the leftmost column a QFD chart, such as that shown above in Figure 2. Next, some means of implementing these features, viz, for transforming each from concept to reality, is conceived for each feature. These means may be thought of as operational devices, in other words, a means of making the desired feature operational. For example, if a desired feature for a coffee pot design were that it not scorch the coffee, the desired operational device would be a timer to shut off power to the coffee pot after a certain amount of time. Once an operational device has been determined for each desired feature, the team assigns a rating to each operational device as to how it influences each desired feature. The usual procedure is to assign these ratings on a scale of 9-3-1: Once again, the greater the rating, the more a feature is affected by an operational device, and vice-versa. Even though the usual scale is 9-3-1, the authors prefer a scale of 9-5-1. This is because it is believed that this scale makes these ratings easier to assign.

The next step is to multiply all combinations of the importance ratings and influence ratings to obtain the relative importance of each operational device: Again the greater the product of these multiplications, the more important the operational device, and vice-versa. For some applications, the “roof” on the house is used to examine the possible interactions between operational devices. However, depending upon the particular application, this step is unnecessary and is often omitted. An example of the above

procedure for the design of a coffee maker is shown in Figure 3.

Figure 3: Example of completed QFD chart

Once the first QFD house is complete, it may be extended into any number of subsequent QFD houses, as necessary for a particular application.

4. APPLICATION OF QFD METHODOLOGY

Ordinarily in the application of QFD, in the first stage of the analysis a team of subject matter experts would be convened to determine what features the product should have. These features would be developed using the Ishikawa diagram. These features would then be arrayed in the leftmost column of a QFD chart. The necessary product characteristics for providing the required product features would then be arrayed across the top of the chart. However for the instant application, surveys from SBI's corporate partners provided the necessary product features, viz. the desired personal attributes, desired by them. Thus, it was only necessary to obtain the required product characteristics, viz. individual skills, necessary to provide the product attributes. These were taken from a skills survey done by the National Association of Colleges and Employers (NACE) done in 2012. The result of this was the QFD Chart shown in Figure 4.

Figure 4: QFD Chart for Phase I

Once the QFD chart was complete, it was distributed to the faculty in the School of Business and Industry (SBI) for completion. Next, the SBI faculty was instructed to rate each of the required personal attributes in descending order of importance from 19 through 1. The faculty was then asked to rate on a scale of 9-5-1 in

descending order the strength of each individual skill to each personal attribute, 9 indicating the strongest relationship, and 1 the weakest. All of these ratings were then added and divided by the number of respondents. These results are shown in Figure 5.

Figure 5: Combined faculty data chart

Next, each characteristic rating was multiplied by each feature rating in order to obtain a rating that reflected the importance of each product characteristic, as well as the degree to which each feature depends upon each characteristic. These responses were then integrated to obtain the final result shown in Figure 6.

Figure 6: Completed QFD Chart for Phase I

The rows were then totaled, as were the columns, and each total divided by the grand total. These operations yielded the percentages to be seen at the end of each row and at the bottom of each column.

5. ANALYSIS OF RESULTS

The percentages to be seen in Figure 5 at the bottom of each column reflect the degree to which a particular skill influences all of the attributes. A comparison of these column totals discloses a very narrow range of results, from 5.5 to 7.79. This narrow range indicates that the desired skills affect the personal attributes desired by employers to approximately the same degree. This indicates that all of the skills recommended by the NACE have approximately the same importance in developing the personal attributes desired by employers. The row totals, on the other hand, indicate the degree to which desirable skills affect each attribute.

As previously noted, the personal attribute rankings from the faculty were averaged. This produced some interesting results in that the highest ranking turned out to be 18 instead of 19, and two attributes, Leadership and Friendly/outgoing Personal-ity, were tied for that ranking. Although, these two personal attributes were ranked the same, the degree to which each was affected by the individual skills differed widely, being 1,728 and 774, respectively. Upon closer examination, these results were consistent with what might be expected. Because Leadership capacity can be learned, it is strongly affected by acquiring the individual skills, while a Friendly/outgoing Personality is more of a function of one's natural disposition. Two personal attributes, Tactfulness and Entrepreneurial Skills tied for a ranking of 17. Again, the effect of the individual skills upon these differed widely, being 765 and 1,054 respectively. The explanation of these is similar to that for those tied at a ranking of 18. Three other personal attributes, Detail-oriented, Flexibility/adaptability, and Creativity were tied at a ranking of 11, and were affected by approximately the same amount by the individual skills, as indicated by numbers in the 726 to 775 range. It is to be noted that these ties caused some gaps in the ranking, as the final rankings were no longer consecutive from 19 through 1.

6. CONCLUSIONS

The foregoing analysis was aimed at completing the first stage of two Houses of Quality to develop a business curriculum that would satisfy the required attributes of SBIs corporate partners. The first stage, arrayed the personal attributes desired by the corporate partners against the individual skills thought to be necessary by

the NACE. This phase 1 analysis will serve as the starting point for a phase 2 of the analysis in which the individual skills will be arrayed against the curriculum areas that are aimed at inculcating those skills. From the second phase, it will be possible to determine which courses best achieve this end. this process is depicted in the Houses of Quality diagram in Figure 7.

Figure 7: QFD houses of quality for business curriculum

REFERENCES

- [1] Akao, Yoji (1990). Quality Function Deployment: Integrated Customer Requirements and Product Design, Productivity Press
- [2] Akao, Yoji (1994). "Development History of Quality Function Deployment". *The Customer Driven Approach to Quality Planning and Deployment*. Minato, Tokyo 107 Japan: Asian Productivity Organization. p. 339. ISBN 92-833-1121-3.
- [3] Benjamin, C.O., Khawaja, Y., Pattanapanchai, S., and Siriwardane, H. (1996), "A Modified QFD Planning Framework for Process Improvement Projects," Proceedings of the 47th International Industrial Engineering Conference, St. Paul/Minnesota, MN, May 18-23, pp.35-39.
- [4] Benjamin, C.O., A. Thompkins, and T. Johnson, (1998), "A Quality Deployment Framework for Planning Course Development," Proceedings of the ASEE Southeastern Section Spring Conference, University of Central Florida, Orlando, Florida, April, pp. 114-121
- [5] Crowe, T. J. and C.C. Cheng, (1996), "Using Quality Function Deployment in Manufacturing Strategic Planning," International Journal of Operations and Production Management, Vol. 16, No. 4, April, pp. 35-48
- [6] Ferrell, S.F. and W.G. Ferrell, (1994), "Using Quality Function Deployment in Business Planning at a Small Appraisal Firm," Appraisal Journal, Vol. 62, No. 3, July, pp. 382-390.
- [7] Khawaja, Y. and , C.O. Benjamin (1996). "A Quality Function Deployment Framework for Effective Transfer of AM/FM/GIS Information Technologies to Small Communities," Journal of the Urban and Regional Information Systems Association (URISA), Vol. 8, No. 1, Spring, pp. 37-50.
- [8] Maddux, G., R. Amos, A. Wyskido (1991), "Organizations can apply QFD as a Strategic Planning Tool", Industrial Engineering, September, PP. 33-37.
- [9] Schubert, M. A., "Quality Function Deployment: A Comprehensive Tool for Planning and Development", IEEE Proc. Natl. Aerospace and Electronics Conf., Vol. 4, 1989, pp. 1498-1503.
- [10] Sule, D.R. (1998): Manufacturing Facilities: Location, Planning and Design, PWS Publishing Company, Boston, MA, pg. 21
- [11] Summers, D. (2005), Quality Management, Pearson Education, Inc., Upper Saddle River, New Jersey.
- [12] Tague, Nancy R. (2004). "Seven Basic Quality Tools". *The Quality Toolbox*. Milwaukee, Wisconsin: American Society for Quality. p. 15. Retrieved 2010-02-05.

Figure 1: Example Ishikawa Diagram

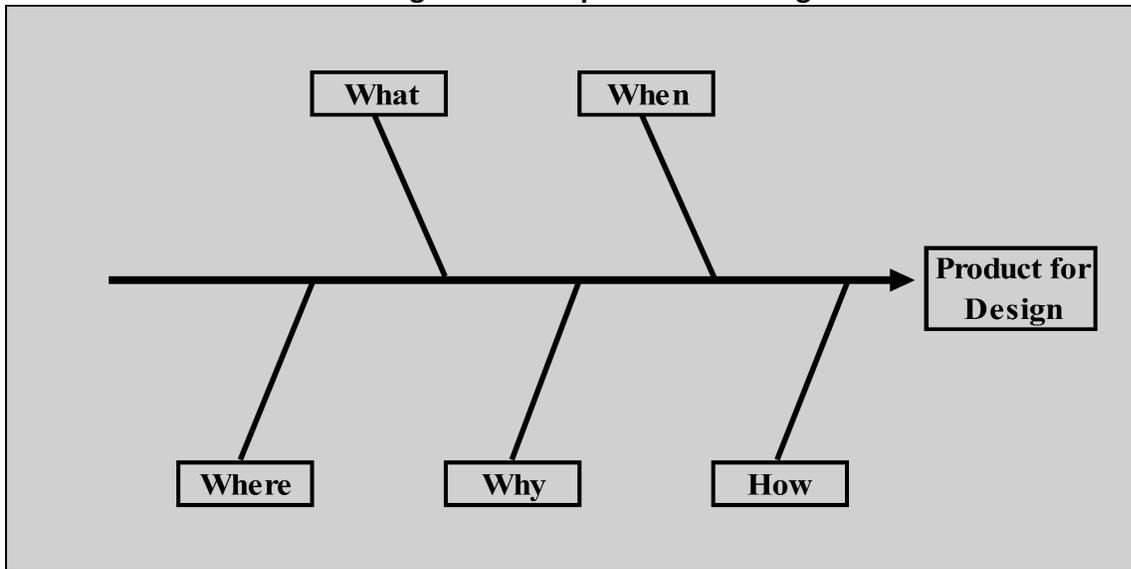


Figure 2: Houses of quality

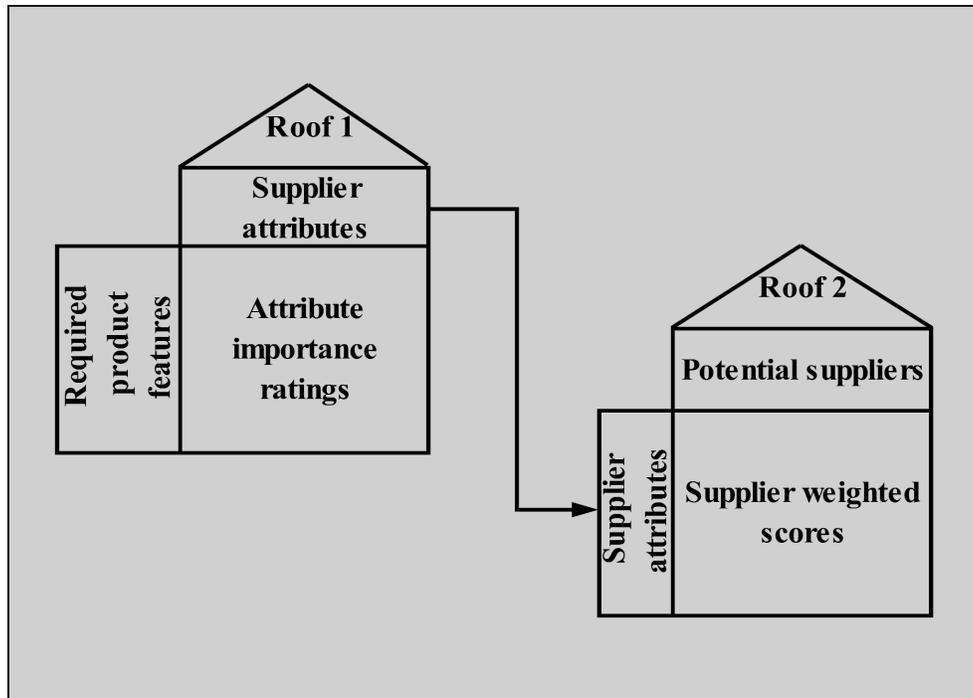


Figure 3: Example of completed QFD chart

| Design Features Customers Want | Auto Shut Off | Few Parts | Stopper | Timer | Double Barrel Coffee Maker | Shape | Size | Thermostat | Control Lever | Sugar & Cream Dispenser | Disposable Filter | Filter Cup (Size/Shape) | Weights | Total |
|--------------------------------|---------------|-----------|---------|-------|----------------------------|-------|-------|------------|---------------|-------------------------|-------------------|-------------------------|---------|--------|
| What | | | | | | | | | | | | | | |
| 2-10 cups | -- -- | -- -- | | | | Δ 9 | ● 81 | □ 45 | | -- -- | | -- -- | 9 | 135 |
| Should not burn | ● 45 | -- -- | | | | Δ 5 | -- -- | -- -- | | -- -- | | Δ 5 | 5 | 55 |
| Easy to clean | Δ 6 | ● 54 | | | | ● 54 | □ 30 | -- -- | | □ 30 | | ● 54 | 6 | 228 |
| When | | | | | | | | | | | | | | |
| Immediately | | | ● 27 | ● 27 | -- -- | | | | | | -- -- | | 3 | 54 |
| At particular times | | | -- -- | ● 27 | -- -- | | | | | | -- -- | | 3 | 27 |
| Multiple times | | | -- -- | ● 18 | ● 18 | | | | | | Δ 2 | | 2 | 38 |
| How | | | | | | | | | | | | | | |
| Hot | | | | Δ 7 | | | | ● 63 | -- -- | -- -- | -- -- | -- -- | 7 | 70 |
| Right taste | | | | -- -- | | | | □ 35 | ● 63 | □ 35 | ● 63 | □ 35 | 7 | 231 |
| Cream/sugar | | | | -- -- | | | | -- -- | -- -- | ● 36 | -- -- | -- -- | 4 | 36 |
| No grounds | | | | -- -- | | | | -- -- | -- -- | -- -- | ● 45 | Δ 5 | 5 | 50 |
| Where | | | | | | | | | | | | | | |
| At home/office | | | | | -- -- | □ 40 | ● 72 | | | | | | 8 | 112 |
| Tabletop | | | | | Δ 5 | ● 45 | □ 25 | | | | | | 5 | 75 |
| Under a counter | | | | | -- -- | ● 72 | ● 72 | | | | | | 8 | 144 |
| Why | | | | | | | | | | | | | | |
| To stay alert | | | | | | | | | □ 5 | Δ 1 | □ 5 | □ 5 | 1 | 16 |
| To dampen hynger | | | | | | | | | □ 5 | Δ 1 | □ 5 | □ 5 | 1 | 16 |
| Score | 51 | 54 | 27 | 79 | 23 | 225 | 280 | 143 | 73 | 103 | 120 | 109 | | 1,287 |
| Percentage | 3.96 | 4.20 | 2.10 | 6.14 | 1.79 | 17.48 | 21.76 | 11.11 | 5.67 | 8.00 | 9.32 | 8.47 | | 100.00 |

| | | |
|---------------|---------------------|---------------|
| Symbol | Relationship | Weight |
| ● | Strong | 9 |
| □ | Medium | 5 |
| Δ | Weak | 1 |

Figure 4: QFD chart for Phase I

| Skills desired by employers (Source: National Association of Colleges and Employers (NACE) 2012 Job Outlook Survey) | Priority | Identify, isolate and find relationships among concepts or problems | Draw sound inferences from multiple perspectives | Develop and present professional quality oral presentations accompanied by appropriate technology, written business documents. | Demonstrate effective interpersonal communication skills. | Recognize and apply concepts, principles and theories in the Business Administration program from the following disciplines: Accounting, Finance, Information Systems, Operations Management, Management and Marketing. | Identify global factors that will impact a business decision. | Analyze the impact of global factors on a business decision | Apply the global factor analysis to a given business decision and/or situation | Identify issues that may present an ethical dilemma, and will articulate the consequences associated with unethical behavior | Identify an ethical dilemma and apply an ethics model to propose and defend a solution | Demonstrate the ability to listen to others | Demonstrate the ability to question team mates without attachment and judgment | Demonstrate the ability to offer assistance to other team members | Demonstrate the ability to exchange, defend, and rethink ideas with team members |
|--|----------|---|--|--|---|---|---|---|--|--|--|---|--|---|--|
| Ability to work in teams | 9 | | | | | | | | | | | | | | |
| Leadership | 16 | | | | | | | | | | | | | | |
| Communication skills(written) | 13 | | | | | | | | | | | | | | |
| Problem-solving skills | 1 | | | | | | | | | | | | | | |
| Strong work ethic | 2 | | | | | | | | | | | | | | |
| Analytical/quantitative skills | 3 | | | | | | | | | | | | | | |
| Communication skills (verbal) | 4 | | | | | | | | | | | | | | |
| Initiative | 6 | | | | | | | | | | | | | | |
| Technical skills | 5 | | | | | | | | | | | | | | |
| Detail-oriented | 11 | | | | | | | | | | | | | | |
| Flexibility/adaptability | 10 | | | | | | | | | | | | | | |
| Computer skills | 8 | | | | | | | | | | | | | | |
| Interpersonal skills | 7 | | | | | | | | | | | | | | |
| Organizational ability | 14 | | | | | | | | | | | | | | |
| Strategic planning skills | 15 | | | | | | | | | | | | | | |
| Friendly/outgoing personality | 18 | | | | | | | | | | | | | | |
| Creativity | 12 | | | | | | | | | | | | | | |
| Entrepreneurial skills/risk-taker | 19 | | | | | | | | | | | | | | |
| Tactfulness | 17 | | | | | | | | | | | | | | |

Instructions:

- Based on your understanding of skills needed for success in the workplace, prioritize the skills needed in the first column. Place your rating in the second column using a scale of 1-19.
- Next rate the relationship between the skills listed in column 1 with the learning competencies listed columns 3-17.

| |
|-------------------------|
| Relationships |
| + Strong relationship |
| ^ Moderate relationship |
| - Weak Relationship |

Figure 5: Combined faculty data chart

| | Priority | Identify and isolate relationships among concepts or problems | Draw sound inferences from multiple perspectives | Develop and present professional oral presentations with by appropriate technology. | Prepare professional quality written business documents. | Effective interpersonal communication skills. | Recognize and apply concepts, principles and theories in the Business Administration program from the following disciplines: Accounting, Business Administration | Identify global factors that will impact a business decision. | Analyze the impact of global factors on a business decision | Apply global factor analysis to a given business decision. | Identify issues that may present an ethical dilemma, and articulate the consequences of the behavior | Identify an ethical dilemma and apply an ethics model to propose and defend a solution | Ability to listen to others | Ability to question team mates without attachment and judgment | Ability to offer assistance to other team members | Ability to exchange, defend, and rethink ideas with team members |
|-----------------------------------|----------|---|--|---|--|---|--|---|---|--|--|--|-----------------------------|--|---|--|
| Ability to work in teams | 9 | 2 | 5 | 1 | 2 | 6 | 2 | 5 | 5 | 5 | 8 | 8 | 9 | 9 | 9 | 9 |
| Leadership | 18 | 4 | 4 | 6 | 5 | 6 | 6 | 6 | 6 | 8 | 8 | 8 | 6 | 9 | 8 | 6 |
| Communication skills(written) | 7 | 4 | 5 | 8 | 9 | 6 | 6 | 2 | 2 | 5 | 8 | 8 | 4 | 6 | 9 | 6 |
| Problem-solving skills | 5 | 8 | 9 | 6 | 8 | 4 | 9 | 9 | 9 | 9 | 4 | 4 | 5 | 6 | 6 | 6 |
| Strong work ethic | 3 | 1 | 5 | 2 | 6 | 5 | 6 | 1 | 1 | 1 | 9 | 5 | 5 | 5 | 4 | 5 |
| Analytical/quantitative skills | 2 | 9 | 8 | 5 | 6 | 1 | 9 | 8 | 9 | 9 | 5 | 5 | 4 | 5 | 5 | 5 |
| Communication skills (verbal) | 5 | 5 | 4 | 9 | 4 | 9 | 6 | 1 | 1 | 4 | 8 | 8 | 8 | 8 | 6 | 6 |
| Initiative | 6 | 5 | 4 | 4 | 4 | 6 | 4 | 4 | 4 | 4 | 2 | 5 | 4 | 4 | 6 | 4 |
| Technical skills | 5 | 6 | 8 | 6 | 6 | 1 | 8 | 8 | 9 | 8 | 2 | 2 | 1 | 2 | 4 | 2 |
| Detail-oriented | 11 | 6 | 8 | 5 | 6 | 2 | 8 | 5 | 5 | 5 | 4 | 4 | 2 | 2 | 4 | 4 |
| Flexibility/adaptability | 11 | 2 | 2 | 4 | 1 | 8 | 2 | 6 | 6 | 6 | 4 | 6 | 5 | 4 | 5 | 5 |
| Computer skills | 10 | 6 | 4 | 6 | 8 | 1 | 6 | 8 | 8 | 8 | 2 | 1 | 2 | 4 | 2 | 4 |
| Interpersonal skills | 9 | 1 | 1 | 9 | 4 | 9 | 5 | 2 | 2 | 2 | 6 | 6 | 8 | 9 | 9 | 9 |
| Organizational ability | 12 | 2 | 6 | 8 | 6 | 5 | 6 | 5 | 5 | 5 | 2 | 2 | 2 | 5 | 4 | 4 |
| Strategic planning skills | 15 | 6 | 5 | 5 | 4 | 2 | 4 | 6 | 6 | 6 | 4 | 6 | 5 | 4 | 4 | 5 |
| Friendly/outgoing personality | 18 | 1 | 1 | 4 | 1 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 6 | 6 | 5 |
| Creativity | 11 | 6 | 5 | 4 | 4 | 2 | 2 | 4 | 4 | 5 | 1 | 4 | 1 | 2 | 1 | 2 |
| Entrepreneurial skills/risk-taker | 17 | 4 | 5 | 1 | 1 | 2 | 2 | 2 | 2 | 5 | 2 | 5 | 4 | 4 | 2 | 4 |
| Tactfulness | 17 | 2 | 1 | 5 | 2 | 8 | 4 | 2 | 2 | 2 | 5 | 5 | 6 | 6 | 6 | 6 |

Figure 6: Completed QFD Chart for Phase I

| | Priority | Identify and isolate relationships among concepts or problems | Draw sound inferences from multiple perspectives | Develop and present professional oral presentations with by appropriate technology. | Prepare professional quality written business documents. | Effective interpersonal communication skills. | Recognize and apply concepts, principles and theories in the Business Administration program from the following disciplines: Accounting, Finance, Information | Identify global factors that will impact a business decision. | Analyze the impact of global factors on a business decision | Apply global factor analysis to a given business decision. | Identify issues that may present an ethical dilemma, and articulate the consequences of the behavior | Identify an ethical dilemma and apply an ethics model to propose and defend a solution | Ability to listen to others | Ability to question team mates without attachment and judgment | Ability to offer assistance to other team members | Ability to exchange, defend, and rethink ideas with team members | Row totals | Row percentages (%) |
|-----------------------------------|----------|---|--|---|--|---|---|---|---|--|--|--|-----------------------------|--|---|--|------------|---------------------|
| Ability to work in teams | 9 | 18 | 45 | 9 | 18 | 54 | 18 | 45 | 45 | 45 | 72 | 72 | 81 | 81 | 81 | 765 | 5.84 | |
| Leadership | 18 | 72 | 72 | 108 | 90 | 108 | 108 | 108 | 108 | 144 | 144 | 144 | 108 | 162 | 144 | 108 | 1728 | 13.19 |
| Communication skills(written) | 7 | 28 | 35 | 56 | 63 | 42 | 42 | 14 | 14 | 35 | 56 | 28 | 42 | 63 | 42 | 616 | 4.70 | |
| Problem-solving skills | 5 | 40 | 45 | 30 | 40 | 20 | 45 | 45 | 45 | 45 | 20 | 20 | 25 | 30 | 30 | 510 | 3.89 | |
| Strong work ethic | 3 | 3 | 15 | 6 | 18 | 15 | 18 | 3 | 3 | 3 | 27 | 15 | 15 | 15 | 12 | 183 | 1.40 | |
| Analytical/quantitative skills | 2 | 18 | 16 | 10 | 12 | 2 | 18 | 16 | 18 | 18 | 10 | 10 | 8 | 10 | 10 | 186 | 1.42 | |
| Communication skills (verbal) | 5 | 25 | 20 | 45 | 20 | 45 | 30 | 5 | 5 | 20 | 40 | 40 | 40 | 40 | 30 | 435 | 3.32 | |
| Initiative | 6 | 30 | 24 | 24 | 24 | 36 | 24 | 24 | 24 | 24 | 12 | 30 | 24 | 24 | 36 | 384 | 2.93 | |
| Technical skills | 5 | 30 | 40 | 30 | 30 | 5 | 40 | 40 | 45 | 40 | 10 | 10 | 5 | 10 | 20 | 10 | 365 | 2.79 |
| Detail-oriented | 11 | 66 | 88 | 55 | 66 | 22 | 88 | 55 | 55 | 55 | 44 | 44 | 22 | 22 | 44 | 44 | 770 | 5.88 |
| Flexibility/adaptability | 11 | 22 | 22 | 44 | 11 | 88 | 22 | 66 | 66 | 66 | 44 | 66 | 55 | 44 | 55 | 55 | 726 | 5.54 |
| Computer skills | 10 | 60 | 40 | 60 | 80 | 10 | 60 | 80 | 80 | 80 | 20 | 10 | 20 | 40 | 20 | 40 | 700 | 5.34 |
| Interpersonal skills | 9 | 9 | 9 | 81 | 36 | 81 | 45 | 18 | 18 | 18 | 54 | 54 | 72 | 81 | 81 | 81 | 738 | 5.63 |
| Organizational ability | 12 | 24 | 72 | 96 | 72 | 60 | 72 | 60 | 60 | 60 | 24 | 24 | 24 | 60 | 48 | 48 | 804 | 6.14 |
| Strategic planning skills | 15 | 90 | 75 | 75 | 60 | 30 | 60 | 90 | 90 | 90 | 60 | 90 | 75 | 60 | 60 | 75 | 1080 | 8.24 |
| Friendly/outgoing personality | 18 | 18 | 18 | 72 | 18 | 162 | 18 | 18 | 18 | 18 | 18 | 18 | 72 | 108 | 108 | 90 | 774 | 5.91 |
| Creativity | 11 | 66 | 55 | 44 | 44 | 22 | 22 | 44 | 44 | 55 | 11 | 44 | 11 | 22 | 11 | 22 | 517 | 3.95 |
| Entrepreneurial skills/risk-taker | 17 | 68 | 85 | 17 | 17 | 34 | 34 | 34 | 34 | 85 | 34 | 85 | 68 | 68 | 34 | 68 | 765 | 5.84 |
| Tactfulness | 17 | 34 | 17 | 85 | 34 | 136 | 68 | 34 | 34 | 34 | 85 | 85 | 102 | 102 | 102 | 102 | 1054 | 8.05 |
| Column totals | | 721 | 793 | 947 | 753 | 972 | 832 | 799 | 806 | 935 | 785 | 917 | 855 | 1021 | 989 | 975 | 13100 | 100.00 |
| Percentages (%) | | 5.50 | 6.05 | 7.23 | 5.75 | 7.42 | 6.35 | 6.10 | 6.15 | 7.14 | 5.99 | 7.00 | 6.53 | 7.79 | 7.55 | 7.44 | 100.00 | |

Figure 7: QFD houses of quality for business curriculum

