## Table of Contents

4-23  *Statistical Analysis of Social Determinants of Health: An Exploratory Study for Global Comparison*  
Ik-Whan Kwon · Sung-Ho Kim · David Martin

24-42  *Improving Costing Methodology Based on Commercial Bank Restructuring*  
T.Tuya

43-61  *Competition in Healthcare Managers: HLA Model*  
Aslı Kose Unal

62-80  *Exploratory Study on Cognitive Style in a BIM Environment in the Australian Construction Industry*  
Marcus Drogemuller · Ryan Muldoon · Joshua Stuart · Ki Pyung Kim · Jun Ahn · Sooam Kim
Statistical Analysis of Social Determinants of Health: An Exploratory Study for Global Comparison

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ABSTRACT

The American healthcare system has become a whipping boy for many global health care professionals who contend that the United States spends more than any other similar countries on health care, yet the health outcomes measured by life expectancy and infant mortality rates of this country have been hovering at the bottom for industrialized nations (Bradley-Springer, 2012). Scholars and researchers in the health care and related fields have been arguing for many years that investment in the health care system alone cannot improve health outcomes (Butler, Bowen and Cabello, 2017).
In the United States, another danger is that financial pressure, the decision makers in healthcare may look for a quick and short term solution (Kim and Kwon, 2015). These scholars and practitioners have developed a different hypothesis to explain health outcomes. They argue that “health” can be explained with a composite measure of medical as well as social determinants of health. Social determinants here are defined in this study as spending not directly tied to financial investment in the medical system. The implication for policy makers is that investment in the medical area alone cannot produce intended positive health outcomes. Rather, a nation’s health policy should address investment in the combined health “basket” (medical plus social agents) to achieve health goals. This study using a few industrialized countries similar to the United States in economic characteristics and political system to investigate statistically how much “social determinants” played a role in determining a nation’s health outcomes. Economic agents are also included in the model to investigate comparative contribution to nation’s health outcomes by these two sample groups. Findings show “social determinants” play a more significant role in determining the nation’s health outcomes compared to economic agents (spending in medical care). Policy implications are addressed at the end of this paper.

**Keywords:** Social Determinants of Health Theory, Life Expectancy, Infant Mortality, Stepwise Regression

**INTRODUCTION**

Health is a complex issue and measuring health outcomes require data for many areas that are not directly related to and impacted by health care. Medical intervention and drug
management are just part of health care management (Laaksonen, et. al, 2005). Many studies demonstrated that social agents in health care such as housing, drug abuses, gun violence, poverty, poor sanitations are also play significant roles in determining the nation’s health (Braveman, et. al, 2011; Bradley-Springer, 2012; Gawande, 2014; Marmot and Allen, 2014). Nevertheless, many researchers especially in medical fields believe that medical intervention coupled with and assisted by unprecedented use of drugs would improve health status of a nation. Health care spending in this country is the largest portion of gross national product (WHO, 2017) and business in pharmaceutical companies is booming providing so-called miracle new drugs almost on a daily basis.

America is the giant “medicated” and over “medicalized” nation in the world (Gawande, 2014). Yet, health outcomes of this country measured by most common health indicators such as infant mortality rate and life expectancy are hovering at the bottom of industrial countries for many years. On the other hand, Park (2006) found that changes in health resources or socioeconomic variables alone may not reduce the state level infant mortality. A new paradigm is needed to explain such poor outcomes and explore a new approach to investigating causes of unexpected relationship between the amount of investment in the health care system and health outcomes.

Most studies in this field of investigation employ a single sample space (country) as a unit of analysis. Although a study with a single sample space (country) may yield statistical outputs convenient to interpret and understand, such research design produces outputs difficult if not impossible for comparative analysis between and among study countries.

The purpose of this paper is to statistically demonstrate what factor or factors determine/ influence health outcomes in
industrialized countries. A multivariate statistical model is used to demonstrate extent of relationship, if any, between economic/social variables (determinants) and health outcomes. This paper is organized as follow: a brief literature review will be presented in Section 2 which is followed by study methods along with sources of data in Section 3. Summary and conclusions will be presented in Section 4. Limitations and contributions of this study will be provided in Section 5.

LITERATURE REVIEW

Health care researchers and practitioners are searching for other disciplines to better understand reasons why the United States has such poor health outcomes in spite of spending almost twice as much on health care as other industrialized countries. For example, the United States spent an average $9,024 per capita in 2015 (see Appendix Table) while other comparative countries in our sample study spent an average a little over $5,000 per capita. In terms of percentage of health care spending to gross domestic product (GDP), the United States spent 16.6% while comparative group spent in average 11.1%. Yet, life expectancy and infant mortality rates of the United States are contrary to what researchers expected: lower life expectancy and higher mortality rates than their counterpart in the study.

The above statistics appear to imply that medical intervention alone has not improved health of the nation. Therefore, it is not surprising that health professionals have looked for other fields of discipline to better understand the relationship between health and the level of investment in health care system. Pioneer work on causes of changes in health status was undertook by McKeown, Record and Turner’s study (1975) on death records for England and Wales from the mid-19th century through the early 1960s. They
found that mortality from multiple causes had fallen significantly and steadily a decade before the availability of modern medical care modalities such as antibiotics and intensive care units. They attributed this decline in mortality rate primarily to social agents such as improved living conditions including sanitation and clean water. Another example can be found in ever widening mortality disparity between social classes in the United Kingdom in the decade following the creation of the National Health Service in 1948 (Black, et. al, 1988). Health outcomes significantly differ among different income groups in spite of universal health coverage for all.

The Canadian Lalonde Report (Lalonde, 1974) acknowledged for the first time that there were other factors external to the health care system in improving nation’s health. Further, Braveman and Gottlieb (2014) reports that large disparity in health status according to social class have been documented across different European countries despite universal access to medical care implying that there are other than medical care impacting the nation’s health. In a study of longitudinal data over 30 years across 34 OCED countries, Rand Europe (2016) found that higher levels of public social spending seem to have a particularly strong relationship with better health (Butler, et. al, 2016). Butler, Mathew and Cabello (2017) argue that focusing heavily on medical services is not necessarily the best way to improve health. Atta (2012), on the other hand argues that quality care with emphasis of patient satisfaction is the best way to improve care under limited resources.

Although there are many different definitions of social determinants in health (SDH), the World Health Organization has the most comprehensive definition. According to their definition, social determinants of health is defined as “the conditions in which people are born, grow, live, work and age” and “the fundamental
drivers of these conditions.” (WHO, 2008). The SDH concept differentiates health attributing to medical care from social inequity of the countries/societies. Some even argue that medical care was responsible for only 10% to 15% of preventable mortality in the U.S. (McGinnis, William-Russo and Knickman, 2002). Marmot and Allen (2014) quoted a Canadian study that shows health care accounts only 25% of health, while socio-economic accounts 50% of health. They even claim that social inequity leads to health inequity. This statement echoes a similar argument advanced by Bradley and Taylor (2011) that “to fix health, help the poor.”

Bradley-Springer (2012) showed that of the ratio of investment in social services to medical services, the United States has a far lower ratio (0.91) than the average ratio of other comparable countries (2.0) ranging from 1.2 for New Zealand to 2.6 for Poland. The U.S. seems to spend more resources on medical care than on social agents. Such an imbalance in resource allocation between medical and social services may have resulted in a lower life expectancy in this country as McGinnis and Foege (1993) concluded in their study on causes of death in the United States. They argue that half of the deaths in the United States involve behavioral causes. Other evidence of attributes to death includes income disparity, education and employment, not directly related to medical care (Braveman, et. al, 2011).

METHODOLOGY

This study uses a cross sectional comparative analysis of selected variables among 10 industrialized countries whose political and economic systems are similar to those of the United States; primarily market oriented economic systems. Countries in sample include: Australia, Austria, Belgium, Canada, France,
Germany, Italy, Netherlands, Sweden, Switzerland, United Kingdom and the United States. Information on selected variables came from the United Nation, World Health Organizations and other sources that publish pertinent health related statistics on a regular basis. Selection of variables that impact nation’s health is rather challenging and limited as this study seeks for a comparative study of pertinent variables that are related to health behavior between the United States and other similar countries. For example, information uniquely relevant to the United States such as income inequality by races may not be so pertinent or relevant to other countries in our sample.

Variable selection, therefore, follows the existing literature on health outcomes and associated variables. The following variables were collected and used in this study.

A. Resources for Health Care
   1. Spending in health care per capita ($); indication of investment in health care system (Source: OECD Health Statistic, 2016)
   2. Percent (%) of spending on health care to gross domestic product; normalized indicator of investment in health care system (Source: OECD Health Statistic, 2016)

B. Health Outcomes
   1. Infant mortality rate per 1000 live births (Source: UN Population Division 2017)
   2. Life expectancy (years) (Source: UN Population Division (2017)

C. Associate variables impacting health outcomes
   1. Income inequality (Gini index). It is a measurement of the income disparity of a country's residents. This variable ranges between 0 and 1(or 0 to 100%) with 0 representing perfect income equality and 1 representing perfect income inequality. (Source: World Fact Book 2015)
2. Insurance coverage (%), percent of people in a country covered by some types of health insurance (Source: OECD Health Statistics, 2016).


4. Gun ownership per 100 residents, another indicator of personal health behavior (Source: Karp, 2007)

5. Gun homicide per 100,000, social behavior (Bingenheimer, Brennan and Earls, 2005) (Source: Preidt, 2016)

**Statistical Analysis**

A simple descriptive statistical analysis was attempted initially to present a snapshot of each variable between two groups (United States vs. others in the sample). A one-sample mean test should reveal the extent of differences in pertinent variables between the United States and the rest of the countries in the sample. A correlation matrix is created to assess the relationship between variables on health outcomes (infant mortality and life expectancy) and associated variables stated above. Finally, a stepwise regression model is created to assess the behavior of each associated variable with health outcomes (infant mortality rate and life expectancy). P < 0.01 and 0.05 were used to make any statistical inferences.

**RESULTS**

**Descriptive statistics**

As shown in Table 1, the average spending on health care by the sample countries excluding the United States is $4,736.55 while the United States spent $9,024, almost twice as much as other
countries. For the proportion of spending on health care to national domestic products, the United States spent 16.66% whereas other sample countries spent 10.66% on health care, almost 40% less than the United States. Table 1 shows relevant information for this research effort. It indicates descriptive statistics and other relevant results.

Table 1: Descriptive Statistics with t-values

<table>
<thead>
<tr>
<th>Item</th>
<th>SP$</th>
<th>SP%</th>
<th>IMR</th>
<th>LEP</th>
<th>GIX</th>
<th>CI%</th>
<th>DOD</th>
<th>GOP</th>
<th>GHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A: Statistics for sample countries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVS</td>
<td>4,736.55</td>
<td>10.66</td>
<td>3.97</td>
<td>81.33</td>
<td>31.13</td>
<td>99.83</td>
<td>2.09</td>
<td>21.82</td>
<td>0.25</td>
</tr>
<tr>
<td>SD</td>
<td>912</td>
<td>0.92</td>
<td>0.58</td>
<td>0.74</td>
<td>3.05</td>
<td>0.35</td>
<td>0.99</td>
<td>10.44</td>
<td>0.20</td>
</tr>
<tr>
<td>1B: Statistics for U.S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UMV</td>
<td>9,024.00</td>
<td>16.60</td>
<td>6.50</td>
<td>79.10</td>
<td>40.50</td>
<td>89.60</td>
<td>6.99</td>
<td>112.60</td>
<td>3.61</td>
</tr>
<tr>
<td>1C: t-values between sample countries and U.S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SP$: Spending($), SP%: Spending (%), IMR: Infant mortality rate per 1000 live birth, LEP: Life expectancy, GIX: Gini Index, CI%: Covered Insured (%), DOD: Drug overdose death per 100,000, GOP: Gun Ownership per 100 residents, GHP: Gun related homicide per 100,000, MVS: Mean value of samples, SD: Standard Deviation, UMV: U.S. mean value, T-stat: T-statistics

In spite of such large spending on health care compared with other similar countries in the sample, health care outcomes of the United States are worse than other countries. For example, the infant mortality rate for the United States was recorded as 6.5 per 100,000 live births whereas the average infant mortality rate for other countries in the sample was 3.97 per 100,000 live births, almost 40% lower than the U.S. Life expectancy also shows that
the United States has the lowest life expectancy among the selected industrial countries (79.1 years vs. 81.33 years).

There seems to be statistically significant difference in income inequality measured by Gini Index between the U.S. and sample countries (40.5 vs. 31.13, p < 0.01). Almost every citizen in the sample countries is covered by some types of health insurances (99.83%) while only 89.6% of the U.S. citizen enjoy health coverage (p < 0.01). Personal health behavior between these two groups also reveal a clear and significant differences; drug overdose death for sample countries is recorded as 2.09 per 100,000 whereas the corresponding information for the U.S. is 6.99 (p < 0.01).

The most striking difference between these two groups is in gun related homicide; 0.25 per 100,000 in the sample countries vs. 3.61 in the U.S. (p < 0.01), a 1,300% difference. Gun ownership follows very closely with gun related homicide; the U.S. has 112.6 guns per 100 households vs. 21.82 for the sample countries (p < 0.01).

**Correlation matrix**

In order to investigate a possible relationship between health outcomes and perceived associated variables, a correlation matrix is produced as shown in Table 2.

**Table 2: Correlation Matrix between Health Outcomes and Explanatory Variables**

<table>
<thead>
<tr>
<th></th>
<th>SP($)</th>
<th>SP(%)</th>
<th>GIX</th>
<th>CI(%)</th>
<th>DOD</th>
<th>GOP</th>
<th>GHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFM</td>
<td>0.591*</td>
<td>0.924**</td>
<td>0.821*</td>
<td>-0.795*</td>
<td>0.717*</td>
<td>0.749*</td>
<td>0.797*</td>
</tr>
<tr>
<td>LFE</td>
<td>-0.616**</td>
<td>-0.660**</td>
<td>-0.225</td>
<td>0.716*</td>
<td>-0.621**</td>
<td>-0.600**</td>
<td>-0.060**</td>
</tr>
</tbody>
</table>

*p < 0.01, **p < 0.05

IFM: Infant Mortality, LFE: Life Expectancy, SP$: Spending($), SP%: Spending (%), GIX: Gini Index, CI%: Covered Insured (%), DOD: Drug overdose death per 100,000, GOP: Gun Ownership per 100 residents, GHP: Gun related homicide per 100,000, T-statistics
a. **Infant mortality rate**: Larger spending on health care does not seem to improve mortality rates either in absolute amount or percentage of GDP on health care (p <0.05 for both cases). As a matter of fact, the directional relationship between investment in health care and health outcomes in both cases is opposite to conventional belief. A further investigation on this relationship needs to be explored in multivariate statistical model next section. Income inequality measured by Gini index appears to negatively impacting infant mortality rates (p <0.01), but not on life expectancy. People in the low income tend to have less accessibility to health care facilities including neonatal care. A negative relationship is, therefore, expected. It is not too surprising to see a positive and significant relationship between infant mortality rates and drug related deaths (p <0.01), gun ownership (p <0.01) and gun related homicides (p <0.01). negative social behavior could create environment at home not conducive for health family formation that in turn may affect infant mortality. As expected, availability of covered insurance seems to reduce infant mortality rates as more pre-natal care is available for expectant mothers and new born babies (p < 0.01).

b. **Life expectancy**: Spending on health care seems to impact life expectancy as Table 2 illustrates either in terms of absolute dollars (p < 0.05) or percent to the gross domestic product (p < 0.05). Similar to infant mortality case, the negative signs in both cases pose an interesting interpretational challenge. The social determinant theory of health argues that spending on health care alone will not improve health outcomes. Reviewing the data (see appendix) between life expectancy and spending (absolute amount as well as percent to gross domestic product), in countries such as Austria, Germany, Netherlands and the U.S., these countries spend more than average on health care, yet their life expectancies are lower than the average (81.33 years) suggesting an inverse relationship. We are not quite certain with this inverse and significant relationship between these two variables. Perhaps multivariate statistical analysis
may shed some lights to this outcome. Nevertheless, this unexpected result seems to support the argument advanced by the social determinants of health to the extreme way, to the least; spending resources on health care alone does not improve health outcomes. Although statistically insignificant, income inequality appears to shorten life expectancy as the literature in general and social determinants of health in particular have argued for many years. People in lower income brackets lack many opportunities to improve the quality of life that may improve life expectancy. Drug abuse and gun violence appear to lower life expectancy as expected \( (p < 0.05 \text{ respectively}) \). Availability of health insurance seems to improve life expectancy as they have more resources for better health care services \( (p < 0.01) \).

It should be noted, however, that not a single social determinant produces unexpected relationship with health outcomes. It is mystery why economic variables (health care spending) produced unexpected relationship with health care outcomes. Perhaps multivariate statistical model sheds some light to this mystery.

**Multivariate Statistical Analysis**

This study employs independent variables advanced by literature in this field of study to assess the degree of association between health outcomes (infant mortality rate and life expectancy) and related independent variables in bivariate analysis model (Table 2). Implications were drawn from the bivariate statistical model. However, health outcome is combination of multivariate factors that affect health status. For example, gun related homicide will be clearly related to gun ownership and insurance coverage implicitly related to income inequality (Gini index). Using
independent variables that may be related themselves in multivariate model may create unusually high multicollinearity that raises interpretational challenges. In order to minimize statistical distortion created by multicollinearity, this paper used a stepwise regression model to extract information on relationship between health outcomes (infant mortality and life expectancy) and associate independent variables. The final results are shown in Table 3A (Infant Mortality Rate) and Table 3B (Life Expectancy).

**Table 3A: Stepwise Regression Model between Infant Mortality and Explanatory Variables**

<table>
<thead>
<tr>
<th></th>
<th>Regression coefficient</th>
<th>Beta coefficient</th>
<th>t value</th>
<th>p value</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>14.364</td>
<td>2.134</td>
<td>.062</td>
<td>.062</td>
<td></td>
</tr>
<tr>
<td>Gini Index</td>
<td>.122</td>
<td>.531</td>
<td>2.804</td>
<td>.021</td>
<td>1.647</td>
</tr>
<tr>
<td>Insurance</td>
<td>-.142</td>
<td>-.462</td>
<td>-2.440</td>
<td>.037</td>
<td>1.647</td>
</tr>
</tbody>
</table>

$R^2 = 0.80$

**Table 3B: Stepwise Regression Model between Life Expectancy and Explanatory Variables**

<table>
<thead>
<tr>
<th></th>
<th>Regression coefficient</th>
<th>t value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>58.358</td>
<td>8.311</td>
<td>0.000</td>
</tr>
<tr>
<td>Insurance</td>
<td>.230</td>
<td>3.246</td>
<td>0.009</td>
</tr>
</tbody>
</table>

$R^2 = 0.71$

Only two independent variables appear to have significant impact on infant mortality rate: income inequality (Gini Index) and Insurance coverage. Variance inflation factor (VIF) indicates practically no multicollinearity between two independent variables. P-values indicate reliable relationship between these two independent variables and infant mortality rate (p < 0.05 for both
cases). R-square indicates a respectable relationship (R\(^2\) = 0.80). Income inequality clearly increases infant mortality rate as many low income groups are unable to afford decent health care facilities. Such interpretation is supported by insurance coverage in the model. Consumers who have any types of insurance coverage seem to lower infant mortality rate as shown in Table 3A.

Only one independent variable (health insurance coverage) entered into the final stepwise regression model for life expectancy model. VIFs for initial model (not shown here) range from 32.045 (gun related homicide) to 36.794 (gun ownership). After several iterations removing unacceptable VIFs, the final model contains only Insurance Coverage as shown in Table 3B. There is a reliable relationship between life expectancy and insurance coverage (p < 0.009) with R\(^2\) = 0.712. The two multivariate models seem to support hypothesis advanced by proponents of social determinants of health. No economic variables (health care spending and % of health care spent on gross disposable product entered into the final model as relevant independent variables.

Implications of Statistical Findings

The results from this study appear to support previous findings by Lalonde (1974), Bradley-Springer (2012) and Braveman and Gottlieb (2014) that social determinants impact health improvement far greater than medical intervention. Researchers and practitioners who advocate and support social determinants of health consistently argue that it is NOT how much one spends on health care that determines the nation’s health outcomes. They argue that other areas in social services (social agent) have to be brought into the picture to assess comprehensive health outcomes of a nation. The results of this study appear to support such theory and arguments in cross country research framework. This study seems to suggest that it is not HOW much resource is spent on
health care. Rather it is WHERE such resources are being spent. Investment in medical devices, drugs and other medical areas that supposedly improve health outcomes have apparently failed to achieve such goals.

This study clearly points other areas of emphasis in improving nation’s health. Mitigating income inequality measured by Gini Index poses a very complicated political challenge. Unprecedented economic growth since 2010 Great Recession has created many “millionaires” in this country. But this economic growth also produced unwanted and unexpected economics “classes”; have vs. have not, resulting in many people in our society “unhappy” that in itself affects nation’s health emotionally as well as physically. Policy change may be needed to correct such income inequality.

This study also reveals another significant variable that affects nation’s health, insurance or lack of insurance coverage. Universal healthcare coverage has been issue for many years in this country. The Affordable Care Act (ACA) has made some inroad reducing many uninsured consumers. There is some evidence that emergency use has been reduced since the ACA was implemented. However, we have a long way to solve uninsured population as political debate on merit of this universal care has been never settled. This country has almost 10% uninsured population. Reducing this uninsured population to the level other economically advanced countries (99.83%) requires a bold political decision.

Study of other countries similar to ours but spend more resources on social aspects of life appears to have produced a better health outcome than the United States. Drug overdoses like we are currently experiencing with the opioid epidemic, gun violence in major cities unparalleled in our history, are some of the social ills that hamper quality of life in our society including health outcomes. Unless and until such obvious social issues are corrected, health outcomes may not be improved. As starter, the ratio of investment
in social services to the medical services should be raised to a minimum 2.0 like other industrialized nations. A national debate on this issue is well overdue.

LIMITATION AND CONTRIBUTIONS

This study has an obvious limitation in that samples are limited to a few countries similar to the United States in economic characteristics as well as political systems. Many countries whose economic and political systems are dissimilar to ours are not included this study such as Japan, China, India, etc. which may produce different outcomes. In addition, this study employed only a few variables that may impact health outcomes of a nation. Many important economic, political and social variables are not included in this study, such as nation’s political system, quality of water/air, retirement systems, number of clinics, quality and quantity of transportation systems, etc. The outcomes may be different from what this study reveals if all of the above limitations are resolved.

Several similar studies have been published on this topic exposing social determinants as significant factors in improving health status. However, most studies use one sample space (country) as a major unit of study. Although such study framework may produce statistical outcomes easy to interpret and generalize, such study framework fails to provide generalized statistical results for policy makers to frame strategic decision to improve health outcomes. This study attempted to provide such missing link by including several similar countries in the study sample. Outcomes from this study, therefore, may be more practical and applicable.

Another contribution of this study includes specific factors that have been cited and supported by literature affecting health status. Income disparity, drug overdose, gun violence, gun ownership and
health care insurance coverage are some of the most pertinent factors that impact health status of a country. This study reveals not only directional relationship between them and health outcome, but also the degree of reliability or lack of reliability in a statistical model. Policy implication can be drawn from such relationship.

Finally, this study employs multivariate statistical model where interactions among independent variables were assessed and managed. As far as we understand, it is first attempt to use such statistical tool to unearth interrelationship among health outcomes and associated factors.

REFERENCES


Appendix: Summary Statistics

<table>
<thead>
<tr>
<th>CNT</th>
<th>PCP ($)</th>
<th>GDP (%)</th>
<th>MRP</th>
<th>LFE</th>
<th>IGI</th>
<th>IC(%)</th>
<th>DOD</th>
<th>GOP</th>
<th>GHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>4,177.00</td>
<td>10</td>
<td>4.6</td>
<td>82.4</td>
<td>34.9</td>
<td>100</td>
<td>3.32</td>
<td>21.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Austria</td>
<td>5,016.00</td>
<td>11.2</td>
<td>3.5</td>
<td>80.5</td>
<td>29.2</td>
<td>99.9</td>
<td>2.99</td>
<td>30.4</td>
<td>0.18</td>
</tr>
<tr>
<td>Belgium</td>
<td>4,611.00</td>
<td>10.6</td>
<td>4.1</td>
<td>80.3</td>
<td>25.9</td>
<td>98.8</td>
<td>1.64</td>
<td>17.2</td>
<td>0.33</td>
</tr>
<tr>
<td>Canada</td>
<td>4,506.00</td>
<td>11.1</td>
<td>5.1</td>
<td>81.4</td>
<td>33.7</td>
<td>100</td>
<td>2.29</td>
<td>30.8</td>
<td>0.5</td>
</tr>
<tr>
<td>France</td>
<td>4,367.00</td>
<td>11</td>
<td>4.3</td>
<td>81.8</td>
<td>33.7</td>
<td>99.9</td>
<td>1.08</td>
<td>31.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Germany</td>
<td>5,119.00</td>
<td>11.4</td>
<td>3.7</td>
<td>80.8</td>
<td>31.1</td>
<td>99.8</td>
<td>1.34</td>
<td>30.3</td>
<td>0.06</td>
</tr>
<tr>
<td>Italy</td>
<td>3,202.00</td>
<td>8.8</td>
<td>3.5</td>
<td>82.3</td>
<td>31.9</td>
<td>100</td>
<td>1.5</td>
<td>11.9</td>
<td>0.71</td>
</tr>
<tr>
<td>Netherlands</td>
<td>5,343.00</td>
<td>10.5</td>
<td>3.8</td>
<td>81.3</td>
<td>28.7</td>
<td>99.8</td>
<td>0.63</td>
<td>3.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Sweden</td>
<td>5,003.00</td>
<td>11.2</td>
<td>3</td>
<td>81.7</td>
<td>26.8</td>
<td>100</td>
<td>2.49</td>
<td>31.6</td>
<td>0.19</td>
</tr>
<tr>
<td>Swiss</td>
<td>6,787.00</td>
<td>11.4</td>
<td>3.9</td>
<td>81.7</td>
<td>32.7</td>
<td>100</td>
<td>1.84</td>
<td>24.5</td>
<td>0.18</td>
</tr>
<tr>
<td>UK</td>
<td>3,971.00</td>
<td>9.1</td>
<td>4.2</td>
<td>80.4</td>
<td>33.8</td>
<td>99.9</td>
<td>3.83</td>
<td>6.6</td>
<td>0.04</td>
</tr>
<tr>
<td>USA</td>
<td>9,024.00</td>
<td>16.6</td>
<td>6.5</td>
<td>79.1</td>
<td>40.5</td>
<td>89.6</td>
<td>6.96</td>
<td>113</td>
<td>3.61</td>
</tr>
</tbody>
</table>

*Gini Index = 1 indicates perfect income equality

CNT: Countries, PC($): Per Capita Spending ($), Percent to GDP (%), MRP: Mortality rate per 1,000 Live Births, LFE: Life Expectancy (years), IGI: Income Inequality (Gini Index)*, IC(%): Insurance Coverage (%), DOD: Drug Overdose Death per 1,000 People, GOP: Gun Ownership per 100 Residents, GHP: Gun Related Homicide

Sources: Various United Nations Publications
Improving Costing Methodology Based on Commercial Bank Restructuring

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ABSTRACT

Although many factors affect the bank’s cost structure, the most important one is the indirect cost weight compared with the cost object. However, it is made clear that the banks cannot appropriately allocate their indirect costs to the cost of products and services, control those costs, and use the output for decision making as a result of a survey conducted for this paper. Therefore, this paper is to explore how to improve costing methodology based on commercial bank restructuring since traditional costing system is defined as the suitable method to solve this issue. The study will provide managers and policy makers with strategic insights and an important method to in commercial bank or similar settings.

Keywords: Commercial bank cost structure, traditional and activity based costing system
INTRODUCTION

In the recent years, there has been a decreasing tendency in the commercial banks’ profitability. On one hand, this is due to the strong competition in the industry and increase in the operating costs. However, it is limited to increase their revenues by changing fees and commissions. Many factors affect the bank’s cost structure, the most important one is the indirect cost weight compared with the cost object. These are urging the banks to control their costs in order to stabilize the profitability and firm performance (Bacon and McMillan, 2007; Lee & Lee, 2014).

This study is aimed to determine how the banks should control their costs using which costing method, and how they should implement it. It is made clear that the banks cannot appropriately allocate their indirect costs to the cost of products and services, control those costs, and use the output for decision making as a result of a survey conducted in this study.

LITERATURE REVIEW

Modern trends of cost management

Managerial accounting is the process of identifying, measuring, cumulating, analyzing information for the pursuit of forecasting, valuing, and controlling entity’s operation. In addition to the process, it is a procedure that create documents and reports by consolidating and analyzing a data from business operations. Management uses this information for decision-making, and it affects the organization’s strategy. Furthermore, management can control their cost by implementing their basic functions of forecasting, motivating, organizing, monitoring, and decision-making (Bakieva & Khashimova, 2017; Rossouw, 2016). Cost management is the process of controlling and planning the budget
of any activity. It aims to supply users with the highest quality products and services at the lowest cost. In order to achieve the goal, the following objectives must be met:

- Determining the costs of the resources required,
- Reducing the costs of the operations that are not adding value,
- Determining efficiency and effectiveness of the operation,
- Determining the operation of measuring performance, permanent improvement, and introducing and implementing new ideas.

Recently, management is continuously developing itself and implementing an innovative cost management method by improving the product’s quality, performance, and lowering its cost. These management methods and initiatives are dependent on each other, and capable to support another. According to Tom Albright and Marco Lam (2006), these methods can be broadly classified into three groups: managing production flow, focusing on strategic management, and reducing process variation.

![Diagram of Information sources of cost]

Source: CAM-I (Gary, 1999)

Figure.1 Information sources of cost
These methods are all connected and consolidated to each other by focusing on permanent and continuous improvement of its business operation. In addition, it seeks to monitor the cost, improve the quality, reduce the cost, and determine the true activity and process. Thus, the main elements of these methods are the activity and process, and these are the basic variables of the activity based costing management. Entity should analyze its activity, cost driver, and performance, and implementing activity based management, in order to continuously improving the entity’s value.

**Costing methods**

Costing methods are classified in to three groups by how it is allocating the indirect cost. Which are:

- **Production level** – Only one incremental cost driver is used for allocating indirect cost, and typically direct labor is used in this level.
- **Unit level** – Cost drivers, that are suitable for segment’s characteristics, are used for allocating incremental indirect cost. In this level, cost drivers are machine time, labor hours, and direct material cost. This level is more suitable method for commercial bank.
- **Activity and operational level** – Indirect costs are allocated by using activity, operation, process cost driver, and the cost drivers are allocated to the final products.

Organization can obtain accurate information about the product and service cost and implementing efficient cost management by choosing efficient cost accounting and costing methods.
In banking industry, traditional and activity based costing methods are used to estimate product cost by using cost drivers to allocate indirect costs into cost object, which is a product. Thus, commercial banks can choose most suitable costing methods among these two.

Source: (Fawzi, 2008)

Figure 2. Costing system

**Traditional costing system**

The process of allocating non-financial costs into different cost objects begins with deciding on which costs must be allocated to cost objects. This method can be classified into two types of approaches which are the partial and full costing system. The partial costing system allocates only a part of the cost, and the full costing systems allocates all the costs. In any of these alternative systems, the cost allocation process is usually a sequential process that consists of two stages. In the first stage, the different cost categories are added to the different intermediate cost objects, and in the second stage, costs are allocated to the final cost objects. Thus, coming back to the classification of transformation costs of banking institutions which differentiated between direct and
indirect costs, it is worth considering the use of partial or full cost systems in banking institutions.

Managerial accounting in commercial banking institutions was introduced relatively later in comparison with other institutions in other sectors. This is one of the reasons for the limited development in managerial accounting. For example, competition in the banking sector situation until the 1980s were not yet serve as an incentive for development of managerial accounting and management planning and control system. On the other hand, banking sectors’ main function is considerably differing from other sectors, because its function is heavily dependent on domestic conditions and performance of companies. Such a transition would hinder the development of the financial sector and industry. In addition, this system explains why the financial institutions initiated full costing system relatively later in comparison with other sectors (Carenys & Sales, 2008, p. 38), and bank needs profit analysis rather than absorbing costs (Mecimore & Cornick, 1982).

Source: (Carenys & Sales, 2008)

Figure 3. Traditional costing system
Similarly, a study, that covered banks of USA, criticized that instead of giving much attention on full cost, bank management gave full attention on cost management and direct costs. However, if the indirect cost increases, direct costing system will become insignificant in functions of planning and monitoring. Thus, this system's potential is limited for the companies (high indirect fixed cost) that have higher indirect cost level and many products. Finally, according to Carenys and Sales, using this system is not appropriate for the financial institutions (Carenys & Sales, 2008).

**Activity-based costing system (ABC)**

Increasing necessity for proper allocation of cost and narrowing production operation has created activity-based costing (ABC) system. During the 1980s, increasing overhead costs was main problem that institutions’ production process has faced. There was no adequate method to manage increasing overhead costs more efficiently. Activity-based costing made a fundamental change in the accounting of overhead costs. In Germany, this method has developed under the name of “operating expense accounting” from 1989. In 1990, in US, Hewlett-Packard, John Deere, Siemens, GM, and other major companies started to focus more on measuring the cost and successfully developed. Japanese manufacturers have been widely used it for controlling cost, discount, restructuring land of production, and create a healthy environment for business.

Since 1980s, researches had been conducted on introducing the ABC system into banking and financial sector. In 1988 Gadner and Lummers (Gadner M & Lammers L, 1988, p. 38) carried out a survey on commercial banks and credit and saving associations of USA in order to indicate current condition of the financial accounting and management control level. The survey result indicated that the intentional distribution of indirect
transformation cost to the product, service, and customers is important to make decisions by the management. In 1997, Innes and Mitchel (Innes, Mitchell, & Sinclair, 2000, p. 360) carried out a survey on 31 biggest banks and financial institutions. The survey result indicated that the ABC system is significant for improving the accounting operation of management of bank and financial institutions.

In 2006, Carenys and Sales (Carenys & Sales, 2008) made survey on 26 savings banks of Spain and 40 commercial banks of USA, and reached the following conclusion as a result:

- It is appropriate to distribute the total costs to the product, service, and customers, not limiting with only direct costs
- Information on indirect transformation costs is significantly important for decisions of administration

Source: (Jan et al., 1994)

Figure 4. Activity-based costing system
ABC system was applied in monitoring and reducing the costs at that time and the common application of this system is seriously beneficial (Bert & Esther, 1994). Traditional and activity-based costing systems are not only differed by its allocating base, it also differs by the second stage cost allocation depending on the number of allocating base that are used. Typically, traditional costing system uses labor hours, machine time, and material (in amount) as allocating base, whereas activity-based costing system uses variety of allocation bases which can be repair time, order number, and number of issues resolved, etc. Thus, the activity-based costing system provides more reliable and accurate product cost than traditional costing system (Innes et al., 2000), (Kaplan, 1988), (Fawzi, A, 2008).

![Diagram of the TCS and ABC systems]

Source: Kaplan et al (1992)

**Figure.5 Comparisons of costing systems**

Even though commercial banks are measuring cost of branch, sub-branches, and product, the activity-based costing system on same level compromises the accuracy of the cost information. It is
necessary for accurate allocation of indirect costs into product or services because of increasing indirect cost due to increasing marketing cost, new technology, and usage of technology.

**CURRENT CONDITION OF MEASURING PRODUCT AND SERVICE COST OF COMMERCIAL BANK**

In commercial banking industry, increasing competition, developments in technology, changes in interest rate, and growth of financial market led to increase the cost of reserves and reduces profit. In addition, growth in industry operation and increasing numbers of customers have led increase in operating cost.

**Current Situation of Financial and Managerial Accounting System of Mongolian Commercial Banks**

**Commercial bank’s financial and managerial accounting system:**

The survey was taken from 47 bank officers, who works in financial accounting, managerial account, and financial planning department, from 13 different banks by face-to-face with an in-person interview and questionnaire. The purpose of this survey was to evaluate commercial banks’ current cost accounting and costing system and to determine current product costing system.

According to the survey result, current commercial bank’s accounting operations are divided into 3 different types of structures (see Table 1).

Financial and accounting activities of commercial banks that operating in Mongolia have concentrated considerably on department of finance. Typically, the main functions of the department of finance are financial budgeting, planning, developing accounting policies and procedures, conducting
financial analysis, and providing financial reports to internal and external users.

Table 1. Banks’ structures

<table>
<thead>
<tr>
<th>№</th>
<th>Department</th>
<th>Bank name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Financial accounting system and control processes are implemented by the departments of finance and accounting, which are under executive management.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structure I</td>
<td>Golomt bank</td>
</tr>
<tr>
<td></td>
<td>TD bank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structure II</td>
<td>Khan bank</td>
</tr>
<tr>
<td></td>
<td>Financial accounting system and control processes are implemented by the departments of finance and operation, which are under executive management.</td>
<td>XAC bank</td>
</tr>
<tr>
<td></td>
<td>Structure III</td>
<td>State bank</td>
</tr>
<tr>
<td></td>
<td>Financial accounting system and control processes are implemented by the department of finance under executive management.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chinggis Khan bank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ulaanbaatar City bank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capital bank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capitron bank</td>
<td></td>
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<tr>
<td></td>
<td>NI bank</td>
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<tr>
<td></td>
<td>Arig bank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bogd bank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Credit bank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trans bank</td>
<td></td>
</tr>
</tbody>
</table>

Source: Calculations by researcher
Financial accounting function is to provide financial reports and information by recording a day-to-day transactions and summarizing those data; however, it cannot record some of the transactions that are related to activities and information.

According to the results of the study, the following common issues of commercial bank can be observed:

- Differences of commercial banks costing are dependable to their asset amount. Cost information necessity is comparatively higher for big and medium sized banks as opposed to small sized banks. With regard to this, big and medium sized banks are trying to estimate their service cost and to enhance the cost estimation accuracy.
- It seems that needs of the product cost information is increased due to the operational expansions for medium and large category banks.
- Banking sector still could not fully estimate their product cost.
- There is needs of improvement on traditional costing system that currently used in banking sector.

In the banks sector, there is a great need to improve and adjust costing system with market requirement; however, this issue has not fully studied yet. In addition, there is still no clear and complete understanding for function and necessity of cost accounting system.

**Commercial bank’s accounting and information system framework:**

Commercial bank’s programs and software are concentrated on information technology department. The information technology departments are responsible to provide reliable, secure, continuous and stable operations of hardware, software, internal and external server, and databases. In addition, the department is
also responsible for constantly updating and developing their programs and software, producing the standards, guidelines, procedures, and process of information technology.

The survey was taken from 28 bank officers, who works in information technology department and executive management, from 13 different banks by face-to-face with an in-person interview and questionnaire for determining the current trends of information technology system. Table 2 shows the programs of commercial banks that are using in 2015.

The accounting software produces reports of financial statements, cash flow statement, balance analysis, and reserve money supply. Management information system is a website based software, and it is used for providing necessary information to all managers and executives.

The principles of the system anticipate a user access to a system which describes the rights for each user actions and statements. The system creates historical data by downloading all account information and transactions related to the account data from basic bank accounting system, such as deposit, loans, collateral as well as off-balance sheet activity, etc. This system has a several disadvantages:

• Currently system generated reports are based on data collected until previous day. In addition, system cannot forecast future based on historical data.
• It cannot calculate the changes on the other information, if one changes some variables. For example, system can produce information in the fastest 5-10 minute, and is some cases it took 15-20 days to generate.
Table 2. Main programs for accounting of the commercial bank accounting

<table>
<thead>
<tr>
<th>№</th>
<th>Bank name</th>
<th>Main program</th>
<th>Information system</th>
<th>Supporting softwares for decision making and management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Khan bank</td>
<td>Banks program</td>
<td>Exist</td>
<td>Does not exist</td>
</tr>
<tr>
<td>2</td>
<td>Golomt bank</td>
<td>Infosys</td>
<td>Exist – Oracle BI</td>
<td>Does not exist</td>
</tr>
<tr>
<td>3</td>
<td>TD bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>4</td>
<td>XAC bank</td>
<td>Flexcube</td>
<td>Exist</td>
<td>Does not exist</td>
</tr>
<tr>
<td>5</td>
<td>State bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>6</td>
<td>Ulaanbaatar city bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>7</td>
<td>Capital bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>8</td>
<td>Capitron bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>9</td>
<td>NI bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>10</td>
<td>Credit bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>11</td>
<td>Chinggis Khan bank</td>
<td>R-Style program</td>
<td>Exist</td>
<td>Does not exist</td>
</tr>
<tr>
<td>12</td>
<td>Arig bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>13</td>
<td>Bogd bank</td>
<td>Grapebank</td>
<td>Exist - Gramis</td>
<td>Does not exist</td>
</tr>
<tr>
<td>14</td>
<td>Trans bank</td>
<td>Macro Opace 5.0</td>
<td>Exist</td>
<td>Does not exist</td>
</tr>
</tbody>
</table>

Source: Calculations by researcher
• Departments get information separately, but it might produce inefficient usage of time and salary cost when information gathered in same time and load increases.
• Downloading some report takes a lot of time. Some time they produce the report manually.
• Data of accounting system is used in banking level, but it cannot be merged or converted into other systems.

In addition, according to the survey results, current commercial banks are not using any software that can provide necessary information to support management and decision-making. Furthermore, the produced reports do not give predictions about future trends. The results of the study have collectively reached the following conclusions. Include:
  • There is no united understanding about a cost.
  • There is no appropriate costing system in current banking sector of Mongolia. Some of the banks are using costing system, but the using systems are incomplete to fully implement the costing system.
  • Current financial accounting systems that are used in commercial banks of Mongolia can only produce information regarding to financial accounting activity; however, it cannot provide necessary information for costing.

There are vital needs of initiating appropriate costing system, which is the major part of managerial accounting system, by changing organizational structure and using appropriate software that can support costing system.
APPROACHES FOR IMPROVING THE COMMERCIAL BANKS’ COSTING SYSTEM

Current financial accounting of commercial bank is providing an accurate information to the user, which is the main purpose of accounting, but it is not providing sufficient information for future operating budgets, planning, and management decision.

In addition, there is an important need of using costing system, and its purpose is to provide information regarding product and service costs to internal users of the organization. Cost accounting provides necessary information for conducting financial and managerial accounting; thus, it is a bridge between these two accounting. The main feature of the cost accounting is that it differs from financial accounting by incorporating quantitative and non-quantitative information at the unit level. Internal users of the commercial banks uses financial and cost information to conduct analysis and researches for future management decisions related to its operations.

Cost accounting can be a source of important information used in making management decisions, but it depends on how the cost information of commercial bank are developed.

Measuring cost

Collecting data of the costs – Cost data are collected by classifications of financial and operational areas. General ledger, payroll, and purchase prices are classified in financial category, whereas reserve driver, operational driver, level, and quantity of output, etc., are classified in operational category. These collected two category data are then combined for preparing the cost base.

Allocating cost data – Allocation can be done in two phases. In the first phase, principles and concepts of the cost are determined.
In the second phase, the most suitable costing methods will be chosen among the costing methods, and then measures the cost.

**Usage of cost information for supporting decision making**

Cost information is used in management decision-making processes, which can be controlling, valuing, forecasting, etc. There is an opportunity to reduce costs and increase profits by understanding the sources of costs and the possibility of controlling it, and this information can be obtained from cost information.

**Processes of measuring cost**

Costing is a process of allocation all the costs into products and services based on consumptions of the resources. This also applies to the process of determining the amount of resources used for each cost objects.

Costing methodologies must adhere to the following principles:

- **Accuracy** – Product cost must be accurate and realistic. If the product cost is same as the source consumption, the costing method is more accurate and optimal for the entity.
- **Efficiency** – Another factor to choose costing is the cost related to using the system and its efficiency. If the costing system is more complex, it might be a relatively costly and efficient than simple systems.

Measuring product cost gives opportunity to determine its cost component. It is necessary to maintain a permanent record for using this information on management decision making.

**CONCLUSION**

Currently commercial bank has no potential to produce
sufficient information that required for optimal decision making, future operating budget and planning. In order to fulfill this information needs, efficient and effective cost accounting and costing system is required. Commercial bank needs to choose appropriate costing system that is suitable for their operations, among the costing methods by implementing related analysis and investing required investment.

Traditional costing system allocates costs based on main cost. The traditional costing system is a less relevant to estimate, plan, and control product cost in the field of commercial banking activity due to its cost structure and characteristic.

ABC system creates sufficient conditions to provide accurate information to management by improving the process of indirect cost allocation to product. The intentional distribution of indirect transformation cost to the product, service, and customers is important to make decisions by the management.

REFERENCES


Competence in Healthcare Managers: HLA Model

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ABSTRACT

In recent years, competencies in corporations have been used in the performance assessment process in the field of human resources. When competencies are accepted as observable behaviors including distinctive knowledge, skills and attitudes in achieving excellent performance. Performance is a concept that determines the outcome of an intentional and planned activity quantitatively or qualitatively. Competencies in assessing corporation and individual performance are key roles. In particular, the determination of the competencies of the managers adds positive value to the managers and to the corporation. It is an effective factor in achieving success and what the managers are aiming for health managers as well, like other managers, to be aware of their competencies. One of the models developed to assess the competencies of health care managers is the Healthcare Leadership Alliance (HLA). This article contains the model for assessment of the competences of the healthcare managers developed by the American College of Healthcare Executives and the studies conducted in this field.
Keywords: Competence, Healthcare Managers, Performance, HLA

INTRODUCTION

For an organization to get maximum output and quality work, it requires effective workforce but with an effective workforce, the organization can only go to a certain distance (Arora, 2016). The use of competencies in reaching the target increases the quality of the work output generated by the workforce. When the results of the use of competencies are related to the quality of service, the application of learning processes is accelerated by determining the areas of competence needed. It is stated that competencies have an important influence on the competitive advantage of the corporations within the sector and between the sectors (Hawary & Bani-Hani, 2009).

Competencies provide managers with an alternative assessment approach to identify career goals of the employees and assess targeted development (Chong, 2013). Employee training and career development provide adequate support towards the potential moderating role of performance appraisal perceptions (Ahmed et.al, 2016). Competencies provide managers with an alternative assessment approach to identify career goals of the employees and assess targeted development. Competence models in the performance assessment process can be used as an important and useful tool for guiding the individual development of employees and managers (Chouhan & Sandeep, 2013). Performance appraisal is one of the basic principles of management; together with tools to assist managers in planning and controlling they are well-defined performance indicators to determine the difference between targeted and actual values and
direct managers to make decisions in accordance with the strategy (Chenhall & Smith, 2007; Muchiri & Cooksey, 2011).

As a result of high-performing and low-performing corporation competence assessment, identifying the competencies that bring success and identifying the deficits of the competencies that cause failure are among the major areas of activity in today's management processes (Bharadwaj & Punia, 2013). The performance of corporations depends on the quality of management, which is more directly related to managerial potentialities and managerial competencies. For this reason, corporations have been concentrating their efforts to improve management qualifications in recent years, especially at the level of implementation. Competencies are managers' micro-skills and they are part of the values that the corporations have. Determination of competences of managers has critical importance in terms of contributing to both the managerial works of managers and the organization they work for (Abraham et al., 2001).

The healthcare managers are largely responsible for execution of the visions and objectives of the health systems. The impact of the healthcare sector on the functioning of the healthcare sector of the community that it interacts with reveals that the competences of healthcare professionals need to be increased to achieve success in this challenging environment. The healthcare managers are accountable to the policy makers and society (public) for the quality of healthcare services. Although effectiveness of the healthcare managers bears professional judgements and skills, it is assessed by demonstrating such skills at individual, team and organizational levels.
LITERATUR REVIEW

Competence in Healthcare Managers

The competence in healthcare services involves the competence supported by the service quality and experience of the employee. Knowledge and skill are important factors in the development of competence and need to be reflected in the behaviors in the daily practices (Kaissi, 2005). In terms of healthcare professions, use of competences contributes to improving the labor quality (Calhoun et al., 2002). The competence levels of the healthcare managers are important in reaching producible results in the healthcare sector (Dwyer et al., 2006). In the studies conducted in the UK, it has been determined that occupational skill is an important factor in the management process. The arrangements (such as shortening waiting times, attitude of the healthcare staff towards the patient in the treatment process, etc.) carried out in the management process provide improvements in the conditions of the patient. The hospital management practices provide an effective way to improve quality and effectiveness. Practices and clinical outcomes among the best and worst hospitals in the world emphasize the potential to improve the hospital performance. According to the results of the research, it is indicated that clinical and managerial skills need to be combined and supported by education (Santric et al., 2011).

Some of the areas of competence defined for healthcare management by Stowe and Haefner (2012) contain the entire healthcare sector, while others contain differences aimed at own characteristics of the healthcare institutions. Management and organizational structure are critical competence areas for managers. This competence involves organizational structure and management processes, understanding the stakeholders and adapting the organizational changes. The professionalism and the ethical competence areas that a healthcare manager has to have
are the work responsibilities and having a regulatory influence when working with the organizations that have been interacted. The differences in the fields of activities of the healthcare institutions and expectations of the people demanding healthcare services require the knowledge needed in the healthcare area. The management knowledge of healthcare managers in the field of healthcare is regarded as a competence area requiring expertise. Competence areas for functional areas are knowledge of human resources, finance, health technology, areas of improving quality and performance, having knowledge on laws and regulations related to the health system and environment. The differentiation of human power in medical and administrative areas of the health institutions requires regulations for increasing the effectiveness of human resources. Being competent in finance defines the competence area that will provide interaction with the healthcare costs, payment mechanisms, reimbursement systems and service providers. The health information systems are the field of competence that contains use of medical and administrative processes of the information technology. It requires full knowledge of the forms of payment in the area of laws and regulations and the role of the state in the regulation of health services. It is also necessary to know the rights of patients and employees (Stowe and Haefner, 2011).

The competence model applied in the health sector in the United States is called HLA. The Healthcare Leadership Alliance (HLA) is comprised of six major professional associations and has more than 100,000 executive members. Professional organizations:

- American College of Healthcare Executives (ACHE)
- American College of Physician Executives (ACPE)
- American Organization of Nurse Executives (AONE)
- Healthcare Financial Management Association (HFMA)
ACHE defines five competences as leadership, communication and interpersonal relationship management, professionalism, management knowledge and skill level and health sector knowledge level for the healthcare managers in different experiences and processes (Stefl, 2008).

Leadership: Differences in the implementation models of the health systems around the world are reflected to the management processes and to the regulations in training programs that raise healthcare employees. The effectiveness of medical leadership in the healthcare team is increasingly recognized for offering an effective healthcare service (Reddy et al., 2015). The focus on leadership in the studies conducted in the United Kingdom is noteworthy, however, it is emphasized that they have failed because medical leadership effectiveness of the clinicians and executive doctors could not provide the balance on the work and management roles between the management and treatment processes. In the study conducted by the participation of 250 people comprising of medical students and doctors working at the hospitals, it is determined that 78% of the participants thought that the content of the medical education was insufficient to develop leadership skills. The training programs are being organized to improve the leadership skills of managers within the framework of training programs developed by the National Health System Institute to close this gap in the UK (Oliver and Carnall, 2011). The managers having the leadership competence ensure improvement of the organizational performance in achieving the goals by contributing to the potential of healthcare employees. Gaining leadership skills is one of the most difficult areas of the
traditional development and it has been identified in the training processes of the leadership development activities that people focus on taking on leadership roles and receiving regular feedbacks on their performance. Leadership development is an activity required for long-term vitality and development of the healthcare management profession. Leadership development in the associations is one of the activities that must be supported by the senior management beyond individual expectations. Participation of young managers in the leadership development programs that increasingly becomes popular must be supported. These programs increase the success of leadership initiatives by providing development of social networks (Gaspar, 2012).

According to the research of McAlearney (2010), half of the hospitals implement nationally developed executive leadership programs. One of the programs was conducted in Egypt and a relation between leadership development and healthcare delivery results was determined. In 2002, in Egypt, a team comprising of healthcare professionals with the titles of physicians, nurses and midwives is organized within the framework of a program funded by the United States and implemented to fill the gap of health management in the central and urban regions of Egypt. Training on leadership and management practices has been given to the participants. According to the study results, these trainings affected the outcomes of the health service delivery and supported the use of leadership training programs in the developing countries by providing evidence that can be continued for at least six months.

b) Professionalism: Professionalism is regarded as a field of competence complementary to other competencies. A healthcare manager is accountable to the patients and the society for the given service and must set the goal of life-long learning and self-development by providing the ability to adapt the personal and organizational behavior in accordance with the ethical and
professional standards. It involves participating in training programs that provide professional development, following publications, proactive career planning and lifelong learning (Evans et al., 2006).

For professionalism, there is a need of modeling for creating an organizational climate. While this modeling can be done within the framework of the ethical rules in the public domain, awarding mechanisms for employees and promotion systems within the organization must be established at the same time. Professionalism is an organizational value and used as a guide for the organization. Training needs must be met for guiding young managers and improving their competencies in the organization (Dye and Garman, 2006).

c) Communication and Interpersonal Relationship Management: It provides communication and interaction with the patient, patient relatives and healthcare staff. A healthcare manager needs the communication and interpersonal relationship competence to maintain work relations effectively. Communication and interpersonal relationship management support the healthcare managers in understanding their employees and their high performance works. Communication and interpersonal relationship management are the areas focusing on communication processes (understanding expectations of the stakeholders, identifying supplementary resources that provide communication) at the organizational level (understanding the activities and practices of public relations by knowing the structure and relations of the organization, creating vision and mission oriented networks), at the departmental level (generating alternative solutions in conflicts, creating teams and ensuring participation). It is inevitable for the managers to encounter conflicts. The healthcare manager having communication
competence feels the conflict in advance and resolves the conflict without causing major problems (Garman and Strong, 2006).

In a survey conducted in India, competences were categorized in two groups in result of the interviews with thirteen managers to determine their competences. The first group covers interpersonal relationships, communication and professionalism, and the second group covers technical expertise taught in education. 31% of the respondents were trained on these subjects, and the only competence that all managers have determined as very important was communication (Rollins, 2003; Broscio and Scherer, 2003; Finley et al., 2007; Kubica, 2008).

d) Management Knowledge and Skill Level: Expresses the competence to apply basic business principles to the health sector within the framework of systematic thinking. In addition, it is stated that especially eight sub-domains are critical. These areas are listed below (Garman et al., 2006).

- Financial Management: This area contains financial information on financial analysis and planning methodologies, indemnifications and financial results. Among the skill areas within the domain, award analysis against risk, management of resources, development / use of monitoring systems and financial planning applications can be counted.

- Human resources: It involves having information on the legal rights and methods increasing motivation of the employees besides safety and health of the staff. The focus is on understanding the human resources systems including labor planning, performance management and management of different environments.

- Organizational dynamics and governance: This area covers change and resistance to change factors as well as understanding the organization. The skill areas on the other hand ensure creation of the opportunity of creative works that provide trust among the
stakeholder groups, develop policies and procedures between the organization and employee and improve performance at the organizational level.

- **Strategic Planning and Marketing**: This area focuses on services offered by the organizations for the expectations of their markets and needs of their consumers.
- **Information Management**: Covers the use of computer and software applications for increasing operational productivity in execution of the healthcare services.
- **Risk Management**: Contains risk and effective management for organizational effectiveness. The methods for reducing risks, malpractices, disaster planning, management and safety of quality and risk management relation are assessed.
- **Quality Improvement**: This area contains monitoring development constantly by using the quality theories, methods and current analytical tools.
- **Systematic thinking**: Considering the importance of entirely understanding an organization, it involves understanding the opportunities to develop the big picture, communication between the internal and external stakeholders and assessment of the impacts and consequences of the decisions.

The applications of management knowledge and skill level competence area particularly concern the healthcare managers. Work experience (when combined with accurate and timely feedback) is the best way to learn the management role; however, this process may show up a bit casually. Often, learning activity provides opportunities for new managers to develop proactive behaviors rather than responding to the offered needs (Dye and Garman, 2006).

e) **Health sector knowledge level**: Understanding the health system, recognizing healthcare actors and performing procedures. The determinants of the health system are the patient, the
employee, the systems and the society / environment (Garman and Tran, 2006).

- **Patient**: In the healthcare sector, the person in the patient role has the minimum experience. The patient experience created by individual differences may be a source of information for the managers by providing a reference. The diversity of patient experiences provides an opportunity to create a realistic picture to meet patient needs.

- **Employee**: The healthcare staff that makes up the workforce of the hospitals is composed of different professional groups. The quality of vocational education must be based on interpersonal trust and cooperation. Individual goals must support organizational strengths and coincide with organizational goals.

- **Systems**: Health systems are not only responsible for raising the health of people but also for ensuring sustainability of the health services.

- **Society / Environment**: “Health Sector” is a general and inclusive concept used to indicate all of the systems and sub-systems established in very different production areas to produce / supply and demand / consume any product in the nature of goods and services that has indirect, direct or actual effects on health as well as the persons, institutions, status, product, etc. that the systems contain. The common objective of the health services is to ensure that people are healthy and make the society healthy by protecting and developing this.

The healthcare managers in different positions meet on a common knowledge base by these five competence areas. According to the developed competency model, each new executive is a novice, the one with more work experiences is at the competent level and the senior executive is an expert or a master. What particularly emphasized here is that the skills require transition from novice to competent, that is to say, experience. It is thought that the
competences necessary to fulfill the role of a manager in a successful organization vary depending on the organizational hierarchy. Recent research emphasizes the behavioral differences of the organizational hierarchy level (Corley, 2004). Most research suggests that healthcare institutions must adopt approaches that will convert competition into an advantage. These approaches have shifted from the role to the necessity of the competences that the profession needs (Huselid, 2005). Mole et al. (1997) suggests in a study that clinical managers are unhappier than the general managers are in relation with the management practices. This is because the clinical managers mostly want to work on their fields (for example clinical workload). Although managers at different managerial levels are supported by the senior management, it is determined that the management development programs they attended create a few behavioral changes in the managers. In many countries, it is seen that most of the physicians that have medical education also take on the managerial roles. Differences were determined between physician and non-physician managers according to their competencies of making strategic decisions. In the research conducted, it is emphasized that there are role differences between the hospital managers that have medical education and the hospital managers that have managerial education, and this is due to the competence level of making strategic decisions rather that the hierarchical level (Schultz et al., 2004). According to the research conducted by Brinkmeyer et al. (2012), the areas, where the healthcare managers need training, are defined as health, governance and corporate management structures, laws and regulations, quality / performance improvement and human resources. The areas that the senior managers assess themselves in the best way are the laws and regulations and this is because of the penal sanctions experienced
against the legal arrangements faced in the repayment and accounting practices in the United States.

The motivation and teamwork competencies have been identified by the healthcare managers in a study on the competencies that the Australian, German and American health managers in the Australian health institutions should have. The administrative functions, such as establishment of short-term planning and control systems, are mostly identified by the German managers, who are generally accepted as the administrative center. The competencies of the hospital managers in the private and public sector in the areas of planning and organizing healthcare services, leadership, auditing, compliance with legal and ethical rules and self-management are measured and assessed by a Likert scale. In conclusion, it is emphasized that the managers in the private sector are more successful than the managers in the public sector are. In a study conducted in the United States regarding medical directors, it is emphasized that competencies must contain clinical skills and the employees in managerial positions must be selected from the ones who also have medical experiences. Similar studies are conducted in the UK and the hospital managers having medical skill deficits are directed to training programs (Pillay, 2008). In New Zealand, the healthcare managers are asked to make assessments on twenty-seven competencies through the web. The analytical skills (decision-making, strategic thinking, flexibility, management quality, political skill), interpersonal skills (team, leadership, communication and cooperation / partnership) and technical skills are considered as the most important competencies by forty-six senior executives according to their answers. It is emphasized that competencies of the healthcare managers must be assessed and training programs must be prepared so as to support professional development of the educational institutions. Six key competence levels were identified
in the project study conducted in Australia to determine the competence levels of healthcare managers. These are defined as decision-making, managing processes and resources, information and organization management in health services, interpersonal communication qualifications and managing relations, managing the organization and change management (Yang et al., 2006). It is emphasized that in South Africa, while public hospitals are often characterized as inefficient and ineffective in terms of factors such as patient dissatisfaction, the private hospitals have steadily rising values and this is also evidenced by the growth in medical tourism. The sample of the study, which is conducted to identify the competence levels of healthcare managers and to find out whether there is a meaningful difference between the competence levels of the managers in different sectors, consists of two hundred and fifteen public hospital managers in six public hospitals and one hundred and eighty-nine private sector managers in nine provinces. Five basic functions (ethics, self-management, control, organization and planning), as well as the needs for training and development, and perceptions of competence levels have been assessed. It has been determined that the healthcare managers participating in the study have the need for development of management. The fact that the public sector managers are over the age of fifty requires these managers to be changed in terms of natural wear and it is necessary to invest in the development of new managers. It is found that the competence level of public hospital managers in evaluating their competencies was "not competent but good" (Pillay et al., 2009).

DISCUSSION AND CONCLUSION

As in other sectors, the quality of management in the health sector is also very different. These differences become more and
more important because of the health dimension. The need for highly motivated managers due to the competitive nature of the healthcare institutions is an important factor on the success of organizations. The healthcare managers have taken managerial roles in clinical and administrative areas. While clinical perspective of clinicians working in clinics as physicians and nurses focus on individual needs, the focus is on patients' needs from a managerial point of view. In terms of evaluating both perspectives, on-the-job training programs should be organized and participation should be supported to develop leadership competencies for the healthcare professionals.

The practices of measuring the competencies of healthcare managers need to be expanded. The emphasis is put on the importance of training on the elimination or reduction of competence deficits are determined by the results of studies on measuring the competencies of healthcare managers. Providing the training support by the assessment of the individual competence deficits of each manager will also increase the managerial achievement level. It could be said that qualified performance outputs would be reached by ensuring optimization of these practices for continuous improvement in the health services.

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Exploratory Study on Cognitive Style in a BIM environment in the Australian Construction Industry

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ABSTRACT

Building Information Modelling (BIM) has been introduced to the construction industry to improve productivity. However, BIM has a limitation to accommodate the cognitive functions of construction
professionals to make proper decisions because BIM requires encompassed digital workflows over a project life cycle that inundate design and construction professionals with a plethora of construction information. Subsequently, construction professionals are not able to have a sufficient time for applying their intuitions and tacit knowledge properly. In order to understand the cognitive styles of construction professionals to make a better decision, this research adopted a mixed method approach comprised of a questionnaire survey and a follow-up interview. Total 105 construction professionals participated in a questionnaire survey, and 15 interviews were conducted. Consequently, the Planning and Knowing styles are the most frequently used cognitive skills for a decision making, and the Creating style is the less frequently used ability for a daily based task. The knowledge and insights of construction professionals are recognised as an essence of better decision making, and BIM is recognised as a knowledge management platform to capture and share the valuable intuitions of construction professionals. Furthermore, proper trainings are required for construction professionals to increase their innovative and creative cognitive skills for their tasks. This research will serve as a stepping stone to further investigate a human aspect in a BIM system, and to provide insights for an organisation or a project team how to adopt BIM for better decision making based on the cognitive styles.

**Keywords:** Cognitive Function, Decision Making, BIM, Australian Construction Industry

**INTRODUCTION**

Recent design requirements of a building have become more irregular and bespoke, and sustainable aspects in a building such
as high energy performance and low carbon footprints have become one of the major considerations in the construction industry. Essential construction information has become more specialized and larger in its volume, and consequently, effective management and integration of the massive amount of construction information have become vital than ever. As a response to the increasing complexity of construction projects, Building Information Modelling (BIM) has been introduced to the construction industry as an enabler to facilitate collaborative efforts among project participants, and to improve fragmented construction practice and productivity (Eastman et al., 2011). BIM is being increasingly adopted in the construction industry due to various benefits including a) Design Quality Improvement; b) Productivity Improvement (Effective and Efficient Project Information Management); and c) Sustainability Enhancement that can be utilized for productivity improvement (Park and Kim, 2017; Eastman et al., 2011). Furthermore, BIM has become a mandate for the public construction projects in various countries including the US, UK, and Australia, and South Korea (Kim et al., 2016).

**COGNITIVE FUNCTIONS IN A BIM ENVIRONMENT**

Although BIM provides various benefits, there are numerous researches pointing out that BIM has a limited capability to accommodate the cognitive functions of construction professionals to make proper decisions. Decision making process is carried out based on a human’s cognitive style, which is described as human’s ability to think, learn and solve problems (Esa et al., 2014). According to Jul and Furnas (1997), the cognitive function is highly required to understand a special information and locate proper information about a design and construction. More importantly, the decisions on design alternatives made at the early design stage
such as building orientation, shape, and structural system, mainly rely on the cognitive functions of designers and engineers as they use their intuitions and insights learned from their experience (Gervásio et al., 2014; Granadeiro et al., 2013). Cognitive styles are the ability for individuals to be able to critically think, and resolve problems, and archive the lessons learned from an event (Granadeiro et al., 2013). According to Cools and Van Den Broeck (2007), the cognitive styles are categorised into three major styles – Knowing, Planning and Creating – as shown in Table 1. Akin (2014) asserted that daily tasks are carried out via a combination of tacit knowledge and intuitive skills, but a BIM environment is not fully capable of accommodating these cognitive functions as design and construction professionals cannot have a sufficient time to utilise their intuitions properly.

Table 1. Three-Dimensional Cognitive Styles

<table>
<thead>
<tr>
<th>Style</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowing</td>
<td>Facts, Logical, Rational, Precision with Tasks</td>
</tr>
<tr>
<td>Planning</td>
<td>Conventional, Structures, Routine</td>
</tr>
<tr>
<td>Creating</td>
<td>Innovative, Open-ended, Creative</td>
</tr>
</tbody>
</table>

Although researchers emphasise the importance of cognitive abilities in a BIM system, BIM is still blamed for its encompassed digital workflows over a project life cycle because design and construction professionals are inundated with a plethora of construction information. Indeed, Foqué (2011) emphasised that intuition and rational thinking should be utilised simultaneously to make proper decisions, and pointed out that the digital workflows in a BIM environment should acknowledge the current limitations and improve the current decision making processes in a BIM environment.
Kopper et al. (2006) recognised that exploring a 3D BIM model often renders a tedious experience to find out accurate and necessary construction information. Dodiya and Alexandrov (2008) elaborated that design and construction professionals, who are not familiar with a BIM environment, experience frustration due to inaccurate spatial cognition as they have been oriented based on 2D drawings. The negative experiences have led the design and construction professionals to resist to adopt new technology and processes (Joo and Lee, 2006; Chai and Chai, 2007). Indeed, the cognitive style is commonly recognised as an important aspect for employers to consider for better work performance as an individual and a team. (Cools and Van Den Broeck, 2007). Esa et al. (2014) highlighted that it is important to appreciate the connection between the construction professionals’ cognitive styles and its impacts on decision makings. A better understanding of design and construction professionals’ cognitive decision making styles will improve construction professionals’ decision making in a BIM environment (Pinch et al. 2010; Carmel-Gilfilen and Portillo, 2010).

However, the cognitive styles of the construction professionals have not been clearly identified. Thus, this research aims to investigate the cognitive styles of construction professionals to make a proper decision. In addition, this research is expected to provide insights for construction professionals how to make proper decisions in a BIM environment based on different cognitive styles.

**RESEARCH METHODOLOGY**

This research adopts a mixed method that is comprised of a paper-based questionnaire survey and follow-up semi-structured interviews because this research is designed to obtain specific
viewpoints and in-depth insights regarding ‘what is the cognitive style of construction professionals’ and ‘how can cognitive styles affect the decision makings’ in the Australian construction industry in real life context (Creswell et al., 2004). The questions adopted a 5 point Likert scale as it is the most popular method among researchers and easy to communicate with respondents (Knight and Ruddock, 2008).

In order to obtain valid and relevant research findings, 105 prequalified construction professionals, who have experience in a BIM-enabled construction project, and have an authority to make a decision, and employed in a nation-wide construction company are selected. The paper-based questionnaire was personally hand-delivered to surveyees to achieve maximum response rate, and the research adopts the Cognitive Style Indicator questionnaire developed by Cools and Van den Broek (2007), which is a widely adopted structured questionnaire to measure the three cognitive styles (See Appendix 1). The questionnaire is comprised of 18 questions designed to measure the following three major cognitive styles: a) Knowing, b) Planning, and c) Creating. A pilot questionnaire survey was conducted prior to the main questionnaire survey to eliminate misleading questions, ambiguity and any difficulty in responding (Polit et al., 2001). After the completion of questionnaire surveys, follow-up semi-structured interviews were conducted with 15 construction professionals, who indicated their willingness.

RESULTS AND DISCUSSION

Total 105 prequalified professionals were responded to the survey. As shown in Table 2, the profile of respondents indicates three major roles – Quantity Surveyor, Project/Construction
Manager, Site Manager – and the portions of respondents are evenly distributed. The profile has been confined to a manager level with decision making authority since this research aim at identifying the cognitive styles for decision making. The average experience of respondents is 9 years, and 20% of respondents (20 respondents) indicate that they have more than 15 years of experience.

Table 2. Profile of Respondents (Total 105 Respondents)

<table>
<thead>
<tr>
<th>Role</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity Surveyor</td>
<td>37</td>
<td>35</td>
</tr>
<tr>
<td>Project/Construction Manager</td>
<td>35</td>
<td>33</td>
</tr>
<tr>
<td>Site Manager</td>
<td>33</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>100</td>
</tr>
</tbody>
</table>

**Overall Cognitive Styles of Construction Professionals**

The overall cognitive style does not present a wide range of variation in its value as shown in Table 3. In the follow-up interviews, interviewees stated that personal preference cannot
overrule the given processes based on their preferences since they have to consider all the possible angles using all three cognitive abilities before they make a decision although they have their own preferred cognitive styles. Based on the comment, the result can be explained that construction professionals utilise three cognitive styles related to analytical knowledge and intuitions for construction projects simultaneously.

Cognitive Styles based on Experience

The cognitive styles of respondents have been further investigated based on their years of experience because knowledge and intuitions are mainly obtained from past experience. As shown in Figure 1, a certain pattern has been presented. As construction professionals have many years of experience, the Knowing such as Facts, Details, Rational, Logical, and Precision about a project have increased. It is obvious that more people experience, more lessons learned and tacit knowledge are accumulated. In contrast, the Planning style such as Planned, Organised, Systematic and Routine present a pattern of continuous decrease. According to interviewees, as construction professionals are located in a higher position over the time, many daily project tasks related to planning and organising are delegated to the professionals located in a lower position while they get involved in more authoring or final decision making processes. Thus, the level of involvement into a project planning based on a position or a rank is reflected on the pattern.

Interestingly, the Creating style related to creative and innovative approaches to a problem or an issue of a project indicates the highest Mean value at the entry level of construction professionals while the most experienced construction professionals indicate a balanced level of cognitive styles in Planning and Creating.
One respondent pointed out that the Creating styles such as innovative thinking are the most important skill required for a construction professional who strives to become from being 'good' to 'great'. The respondent was a recruiter, and he mentioned that the creative or innovative thinking is a factor in the recruitment process for graduates. Thus, it is evident that the entry-level professionals indicate more Creating styles. Respondents unanimously agreed that the Creating style might be the most important cognitive thinking style.

Respondents emphasised that the need for a construction professional to be innovative including learning advanced construction technologies including BIM and other ICTs will be a key competence in the construction industry. Furthermore, construction companies continuously invest in reinventing and training employees to improve productivity. In terms of highly experienced professionals, they can adopt a balanced perspective between the Planning and Creating styles based on their

Figure 1. Trend of Cognitive Styles

x-axis: years of experience, y-axis: Mean value
knowledge (the Knowing style) as they are highly experienced in various construction projects.

**Cognitive Styles based on Roles**

The cognitive styles based on the roles of respondents have been investigated to identify if there are any differences in the cognitive styles based on duties of each role. As shown in Figure 2, the site manager indicates the highest level of Knowing style, and the project manager indicates the highest level of Creating style among three roles. The Planning style is indicated higher level at the project manager and the quantity surveyor compared to the site manager.

![Figure 2. Cognitive Styles based on Roles](image)

_x-axis: Roles, y-axis: Mean value_

**Project Manager**

Three cognitive styles are presented in a balance for a project manager, while a site manager and a quantity surveyor indicate relatively large differences. The Creating style indicates the
highest level, and an interviewee elaborates that more experienced project manager can resolve issues and problems in a creative way, and motivate project team members to develop innovative ideas.

Furthermore, an interviewee, who is a project manager, commented that the duty of a project manager is required to plan and organise a project, and delegate tasks, and monitor work performances of project team members over a project life cycle. Consequently, well-balanced cognitive skills are required to carry out the given tasks, and this is why three cognitive styles are evenly indicated high and balanced for a project manager.

**Site Manager**

The site manager indicates predominance in the Knowing style, which is mainly related to insights and intuitions based on their experience and knowledge. As a site manager mainly works at the construction site, various site works require their immediate attention and decisions, which might be related to risks.

Furthermore, there may not be sufficient time for them to analyse the entire situations and possible options, which is relevant to the construction site. One interviewee stated that the level of education or a type of education might impact on the cognitive style of a site manager since a typical site manager started his/her carrier from a tradesman while a project manager and a quantity surveyor typically complete a university degree course. Thus, it is identified that more intuitive and prompt response is required for a site manager to carry out the tasks.

**Quantity Surveyor**

The quantity surveyor heavily relies on the Planning style as they are responsible to analyse and estimate costs and develop a cost management plan. Interviewees commonly stated that a standard for developing a bill of quality such as the Australian
Standard Method of Measurement has already been well established. The standard is currently used across the supply chain of the construction industry to estimate all the construction works. Thus, a quantity surveyor presents a tendency to reply in the Planning style. One interviewee pointed that most of a quantity surveyors’ work related to costs and risks, i.e. numbers, and it is why using a commonly accepted standard is important compared to inventing a new way of measuring and planning costs. Based on this comment, it can be extrapolated why the Planning style is indicated high for a quantity surveyor.

Reflections on Cognitive Styles and BIM
The Planning style is recognised as the most preferred and frequently used cognitive style for each profession regardless of the number of years of experience. As BIM is capable of organising and planning diverse construction information over the life cycle, it can be considered that BIM can accommodate the Planning style, and even enhance the cognitive abilities (Akin, 2014). For project managers and quantity surveyors, the Planning abilities can be improved by adopting a BIM capability for time and cost estimation, which is named as 4D and 5D BIM capabilities. Effective coordination of design alternatives and informed decision making and instant updates on costs based on design alternatives throughout a project life cycle is the most important capabilities of 4D and 5D BIM. These BIM capabilities are equivalent to the Planning cognitive abilities that are required the most for a project manager and a quantity surveyor to carry out their tasks. Thus, 4D and 5D BIM capabilities would be the best way to utilise BIM for enhancing cognitive decision making processes and improve project productivity (Kim and Park, 2016).

In contrast, the Knowing style is the most frequently used cognitive style for a site manager. Interviewees commonly stated
that site managers take their roles based on their varying amounts of experience from the construction field as a tradesman. In addition, the majority of site managers have a trade background, and the trading based experience is highly valuable for the job since they should be able to fully understand the requirements as an onsite supervisor daily basis. Thus, it is evident that site managers indicate the Knowing styles as their preferred cognitive skills as it utilise their experience and intuitions.

In alignment with the importance of knowledge from the past experience, there have been recent researches focusing on the knowledge management using BIM for construction tasks, safety and risk management (Ding et al., 2016; Deshpande et al., 2014; Pishdad and Beliveau, 2010). The studies assert that tacit knowledge from construction personnel should be captured and shared for better decision making and improved safety and risk management. More importantly, the essence of the knowledge management framework based on a BIM system is a ‘human being’, not a software or technical skills. Based on the studies, the construction industry should archive the insights and intuitions of a site manager, and share it with project team members via a BIM system to facilitate the Knowing cognitive skills. All the interviewees agreed that creativity is required more than ever in the construction industry, while they also argued that typical day to day tasks are not necessarily required innovative approach, which requires a learning curve or extra efforts to make it works.

Consequently, the Creating cognitive skills are often considered as less important compared to other two Knowing and Planning cognitive abilities under the tight construction schedule. However, many construction companies are keen on investing their capital in advanced technologies and relevant trainings for employees, and the creative and innovative approach to a new technology and new workflows are essential to achieve a competitive advantage against
other companies. Indeed, BIM is a new methodology and an ICT technology to deliver a project outcome to a client with agreed quality, cost and time, and interviewees also agreed that proper and timely training for BIM and any other relevant new ICT technology would help them to increase the Creating cognitive abilities as well as other cognitive abilities.

CONCLUSION

This research investigates three major cognitive styles – Knowing, Planning and Creating skills of construction professionals – to make a proper decision in a BIM environment. A mixed method comprised of a questionnaire survey and an interview was adopted to identify the most frequently used cognitive styles based on the number of years of experience and the roles of respondents including a project manager, a site manager, and a quantity surveyor. As a result, the Planning and Knowing styles are the most frequently used cognitive skills for a decision making, and the Creating style is the relatively less frequently used ability to make a decision for a daily based task.

This study recognised that the 4D and 5D BIM capability to manage time and cost of a construction project can be an enabling tool to enhance the Planning and Knowing cognitive abilities of project managers and quantity surveyors. A knowledge management capability of a BIM system can be potentially used to capture and share the knowledge and intuitions of construction professionals and eventually can enhance the Knowing styles, which is the most preferred cognitive style for a site manager.

It is also revealed that the construction industry increasingly requires a creative and innovative idea, which is the Creating cognitive ability, to improve productivity and make a better decision. Furthermore, proper trainings are required for
construction professionals to increase their innovative and creative cognitive skills for their tasks. The research findings are expected to serve as a stepping stone to further investigate human cognitive abilities in a BIM environment, and to provide insights for an organisation or a project team how to adopt BIM for better decision making based on the cognitive styles.

**ACKNOWLEDGEMENTS**

The authors would like to thank the Australia-Korea Foundation for its support for research collaboration between Australia and Korea

**REFERENCES**


Appendix 1 – Cognitive Style Indicator Questionnaire

Please indicate to what extent the following statements specify you.
1- Strongly Disagree
2- Disagree
3- Neutral
4- Agree
5- Strongly Agree

1. I like much variety in my life.  
2. I study each problem until I have understood the underlying logic.  
3. I prefer well-prepared meetings with a clear agenda and strict time management.  
4. I like to contribute to innovative solutions.  
5. New ideas attract me more than existing solutions.  
6. I make definite engagements which I follow-up meticulously.  
7. I try to avoid routine.
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<th>Statement</th>
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<tr>
<td>8</td>
<td>I want to have a full understanding of all problems.</td>
<td></td>
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<td>9</td>
<td>Developing a clear planning is very important to me.</td>
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<td>10</td>
<td>A good task is a well-prepared task.</td>
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<td>11</td>
<td>I prefer to look for creative solutions.</td>
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<td>12</td>
<td>I always want to know what should be done when.</td>
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<td>13</td>
<td>I like to analyse problems.</td>
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<td>14</td>
<td>I like to extend the boundaries.</td>
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<td>15</td>
<td>I make detailed analyses.</td>
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<td>16</td>
<td>I prefer clear structures to do my job.</td>
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<td>17</td>
<td>I am motivated by ongoing innovation.</td>
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<td>18</td>
<td>I like detailed action plans.</td>
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Management Review: An International Journal (MRIJ)

Objectives

Business management is a primary area of market competitiveness and sustainability in all types of industries. Managerial insights in the global and/or local business are major drivers of organizational innovation, business dynamics and business value chain. Managerial review will be an integral player in the 21st knowledge industry and economy.

Nevertheless, how to foster managerial review and insights have not been appropriately explored in terms of global or local business perspectives. In fulfilling of this urgent and timely theme, business management need more sustainable profitability, better operational excellence, higher goods and services quality, more proper market promotion, stronger leaderships, and more accurate financial planning in order that business organizations are more competitive.

This journal’s main objective is to establish an outlet for executives, managers, educators, and researchers interested in a variety of topics in business management and insights in terms of global or local perspectives. Thus, papers will focus on the global or local implications of managerial review and insights in business settings.

Subject Coverage

Examples of topics appropriate to the theme of management review include:

- Case studies of business management
- Business decisions and insights
Notes for Prospective Authors

Submitted papers must original manuscripts that have neither been previously published, nor currently reviewing for publication elsewhere. Full author guideline, academic research ethics and copyright agreement policies are available upon requests. All submitted manuscripts are refereed through a double blinded peer review process. KINFORMS, a subdivision of INFORMS, USA, has published the Journal twice a year, June 30 and December 31, respectively.
Management Review: An International Journal

Editorial Policy
Management Review: An International Journal (MRIJ) publishes intellectual findings to academies and practitioners in profit and non-profit organizations as well as local and global institutions on all aspects of managerial issues. MRIJ promotes the findings of sharing knowledge, exchanging experience and creating new ideas between academists and practitioners. MRIJ encourages all manuscripts of multi-disciplinary and cross-functional approaches with theoretical and empirical, technical and non-technical, and cases studies related to managerial issues in certain individual organizations, societies, countries. The journal is a double-blind referred journal.

Manuscript Submission
Your manuscript should be original contents that are not copyrighted, published, accepted for publication by any other journal, or being reviewed to any other journal while being reviewed by the Journal. Your manuscripts should be formatted with Century 12 points, double-spaced, left-aligned, 2.5 inches of top, 1.5 left and right, and 2 bottom margins on international standard (letter) size. The manuscript size may be between seven and fifteen pages. Manuscripts should follow generally accepted manuscripts printing guidelines. All manuscripts should be electronically submitted to the managing editor at leecw@hanyang.ac.kr with a copy of mrij.office@gmail.com. More details are at http://www.kinforms.net.