Idea Management System Application Type Impact on Idea Quantity

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Abstract

Idea management system application considers idea quantity as the key to idea management success. The aim of this paper is to examine how different idea management system application types impact idea quantity. The authors conducted empirical research by conducting a survey based on adaptive structuration theory framework. In the research paper, an analysis of 447 responses was included. The study shows how to separate idea management system application types impact by idea quantity. The target group consisting of commercially available web-based idea management system applied enterprises may limit the generalisability of the results. The study contributes to the discussion about the idea management system application type impact on the idea management results by showing that different idea management system application types lead to different idea management results.

KEYWORDS: Idea management systems, Idea quantity, Survey research, Web-based idea management, Innovation.

Introduction

Innovation management and application of information technologies in organisations has become increasingly more relevant over the last few decades. Web-based idea management systems (IMS) fall in line with the current developments (e.g. growing importance of ICT, the spread of open innovation and co-innovation, etc.) in all previously mentioned considerations. IMS is a manageable systematic tool to generate and evaluate ideas. The use of web-based IMS has become a part of the organizational culture in various enterprises and Web-based IMS are used by many well-known organizations such as Boeing, P&G, Volkswagen, Xerox, Pentax, Heineken, Panasonic, Sony, Fujitsu, Electrolux, Volvo, etc. The authors expect that throughout the following years the role of web-based IMS will grow as even more organizations will start to apply them. Many good examples show positive effects on organizations performance that use web-based IMS. For example, BT Group is using its IMS Webstorm which helped the company acquiring 10 000 new ideas in the seven years between 2005 and 2012. Realization of these ideas has helped the company to increase its revenue by 100 million pounds and improve customer loyalty (Bright Idea, 2010). Another example is Bruce
Power, the only privately owned nuclear power station in Canada. In two years since it started using IMS Idealink Open, it has acquired more than 2700 new ideas and more than 10,000 participants have participated in their IMS process (generation, development). The use of IMS can lead to both a decrease in costs and an increase in revenue (Brain Bank, 2014). Application cases show that this tool gives the possibility to connect internal and external idea creators and evaluators in the idea management (IM) process and these systems could connect different entrepreneurship areas, for example, intrapreneurship and innovation management, opportunity identification and creation. But there is a lack of research on the web-based IMS application types and their respective results. Authors of this paper aim to explore web-based IMS application type impact on its application results. To fill the gap, authors apply theoretical and empirical approach with the main aim to examine how different IMS application types impact IMS results.

Applegate (1986) is the first researcher mentioning IM and to begin IM and IMS research. Since then there have been several academic perspectives on how to research IM and IMS. A majority of researches focuses on systematic aspects of IM and IMS (e.g. Bailey and Horvitz, 2010; Barczak et al., 2009; Bjork and Magnusson, 2009; Coughlan and Jahnson, 2008; Flynn et al., 2003; Galbrait, 1982; Gish, 2011; Green et al., 1983; Korde and Paulus, 2016; Vandenbosch et al., 2006) and structural (e.g. Bassiti and Ajhoun, 2013; Bergendah and Magnusson, 2014; Divakaran, 2016; Luo and Tobia, 2015; Narvaez and Gardoni, 2015; Poveda et al., 2012; Summa, 2004; Voigt and Brem, 2006; Westerski and Iglesias, 2011; Wooten and Ulrich, 2015). Structural literature sources focus on design and the process, but systematic literature sources focus on social capital, creativity, cognition, etc. (Rose and Jensen, 2012). Authors have revealed in the previous researches that there are multiple types of research available with a structural perspective that provide a theoretical base for IMS concept exploration. Literature about IMS overview mostly focus on existing IMS and their application and potential improvements (e.g. Summa, 2004; Bakker et al., 2006; Coughlan et al., 2008; Bothos et al., 2008; Bjork et al., 2009; Barczak et al., 2009; Beretta, 2015; Tung et al., 2009; Bailey et al., 2010; Hrastinski et al., 2010; Holzblatt et al., 2011), but some researches also aim to research development of new IMS (e.g. Flynn et al., 2003; Vandenbosch et al., 2006; Bothos et al., 2009; Iversen et al., 2009; Bansemir et al., 2009; Bettoni et al., 2010; Xie et al., 2010; Bothos et al., 2012; Lowe and Heller, 2014). This paper aims to be part of the first type of papers which explores existing systems focusing on commercially available systems. Most researches that explore existing IMS research focus on one or a few IMS but this research is based on a survey across multiple different IMS users.

IMS has not been given sufficient scientific attention and it should be researched how different IMS types impact its application results (van den Ende et al., 2015). This research is aiming at providing a contribution to fill this gap. First, the paper will help researchers and IMS users to understand the basic IMS application types and their potential results. Second, the exploration of different IMS types and their results could motivate entrepreneurs to re-evaluate their current approach to IM. Third, developers and users of web-based IMS see the potential of these systems but positive outcomes often do not occur and that is one of the reasons why organizations do not use them in the long term (DeSanctis and Poole, 1994). Due to these reasons, it is important to explore web-based IMS application types and their results, to explain what results companies could expect based on different application types.

In this paper, IM is defined as a systematic, manageable process of idea generation, evaluation, and repeated idea generation and evaluation. The IMS is defined as a tool, tool kit or complex system which provides systematic, manageable process in IM (Mikelsone and Liela, 2015). The authors use 2 IMS classifications: based on involved idea sources (internal, external, mixed) and based on the application focus (active, passive). The research aims to answer the research question: How different IMS application types impact idea quantity? To answer these questions 4
hypotheses will be tested that are based on the 3 types of IMS and 4 dimensions of the results:

- (H1) Active IMS provide higher idea quantity than passive.
- (H2) External IMS provide higher idea quantity than internal.
- (H3) Mixed IMS provide higher idea quantity than internal.
- (H4) Mixed IMS provide higher idea quantity than external.

Figure 1 summarizes the motivation for this paper.

Figure 1
Research development motivation

Use theoretical and empirical approach to examine how different IMS application types impact IMS application idea quantity.

Main literature gap – no research on how IMS application types impact idea quantity.

IT application and innovation management in organizations is more relevant now than ever before. Trends to match – (1) in the age of knowledge tools that provide means for acquiring, evaluation and development of knowledge and ideas are extremely important; (2) the growing role of ICT increases the importance of web-based tools that support the innovation process; (3) web-based IMS is becoming more important in the context of open innovation and co-innovation, giving them access to both internal and external sources of ideas and knowledge.

This paper fulfils an identified need to clarify IMS types and their impact on idea quantity. This paper creates academical contribution: it researches different classifications of IMS and their impact on idea quantity. Practical contribution - web-based IMS application types and their idea quantity could help to evaluate the potential application of IMS in different scenarios.

The rest of the paper is structured as follows. The second section introduces the theoretical background. The third section continues by presenting the research methodology. The fourth section provides the answers to the research questions through conducted research. This structure can be seen in Figure 2.

Figure 2
Paper Structure

| Research instrument | Data collection | Data analysis | Research instrument | Data collection | Data analysis |
|---------------------|-----------------|--------------|---------------------|-----------------|--------------|
| Methodology         | Findings        | Conclusions  |
| Basic data characteristics | IMS application type impact on idea quantity | Summary Implications Future research directions |

Source: created by author’s

**Theoretical background**

**Idea management system basic assumptions**

In this paper, the definition of the IM is based on the following assumptions that that IM is: (1) systematic process; (2) manageable process; (3) main parts of IM are idea generation, evaluation, and repeated idea generation and evaluation (if it is needed). Based on these assumptions IMS is a tool, tool kit or complex system which provides systematic, manageable process in IM (Mikelson and Liela, 2015). Table 1 provides a detailed description of IMS, characterising all previously mentioned elements with its sub-elements.
IMS - tool, tool kit or complex system which provides systematic, manageable process of:

| Idea generation (preparation, capture/gathering of ideas, retention, enhancement) | Idea evaluation (screening, selection, retention) | Continuation of IM (concept development, distribution of ideas, support during implementation with repeated IM and rewarding, retention) |
|---|---|---|
| e.g. Korde and Paulus, 2016; Wooten and Ulrich, 2015; Summa, 2004 | e.g. Westerski, 2013; Summa, 2004 | e.g. Summa, 2004 |

*Source: based on Mikelsone, Volkova and Liela (2019)*

There are 3 IM types: external, internal and mixed IM. External IM means external idea generation and evaluation (main IM sources – experts, partners, customers and other stakeholders outside the organization) (e.g. Bothos et al., 2008; Tung et al., 2009; Westerski et al, 2011; Bothos et al., 2012). Internal IM is internal idea generation and evaluation in an organization (main IM source employees) (e.g. Iversen et al., 2009; Fatur et al., 2009; Bansemir et al., 2009; Glassmann, 2009; Klein and Lechner, 2010; Bettoni et al., 2010; Selart and Johansen, 2011; Shani et al., 2011; Moss et al., 2011; Deichmann, 2012; Aagaard, 2012, 2013; Poveda et al., 2012; Bassiti and Ajhoun, 2013, Wood, 2003). Mixed IM - idea generation and evaluation involving internal and external sources (e.g. Fritz, 2002; Nilsson et al., 2002; Voigt et al., 2006; Brem et al., 2007; Enkel et al., 2009; Brem et al., 2009; Sandstrom and Bjork, 2010; Baez and Convertino, 2012).

**Idea management system application types**

For this research the authors have applied two categories for classifying IMS application: (1) based on the involved IM source; (2) based on the IM application focus.

There are other possible categories for IMS classification: based on the provided process functions (limited, full, extra) and based on the IMS price type (monthly payment, yearly payments). The last two types of classifications will not be investigated further as they focus on systems, not on their application type.

Authors based on the ideas divide all IMS application cases as follows:
- internal IMS by involvement internal idea creators and evaluators;
- external IMS by involvement external idea creators and evaluators;
- mixed IMS by involvement internal and external idea creators and evaluators.

Based on the application focus all systems could be divided as “active” and “passive”, therefore, there are passive and active IMS. Passive IMS collect all ideas in an unfocused manner, but active IMS provide functions to collect ideas in a focused manner and most cases includes idea evaluation possibilities. IMS type descriptions are provided in Table 2.

| Passive IMS | Active IMS |
| --- | --- |
| **Classification criteria: based on the application focus** |
| Functions | Type of focus | Functions | Type of focus |
| Focus on idea generation | Unfocused process | Focus on all IM dimensions | Focused process |

| Classification criteria: based on the involved IM source |
| --- | --- | --- | --- |
| Description | Main IM source | Description | Main IM source | Description | Main IM source |
| IMS that allows involving only internal IM sources | Employees | IMS that allows involving only external IM sources | Crowds, experts, clients, etc. | IMS that allows involving internal and external IM sources | Employees; clients, experts, crowds, etc. |

*Source: based on Mikelsone, Volkova and Liela (2019)*
Idea Management System Application Results

Quality and quantity of ideas are most often used as measurements for IM and IMS application, and as a result, should be considered as the main elements of the web-based IMS application outputs. Denis and Garfield (2003) have revealed that decision support system processes may encourage more participation that also provides a challenge to research this element in the IMS context. Wooten and Ulrich (2015) had researched feedback importance in the idea management process, based on the conclusion that managers face a decision about if and how to provide in-process feedback to the idea generators about the quality of submissions. Their research revealed that directed feedback benefits the average quality of entries submitted. The stimulus that impacts web-based IMS application and its results can also be researched. The authors have concluded that there is no common view on IMS output elements, except idea quality and quantity, and involvement. It would be advisable to create IMS effectiveness evaluation tool that would include the most important output elements. In this research, authors will apply the most frequent researched IMS output variables - idea quantity, idea quality and involvement. Idea quality could be defined as the average quality of generated ideas (idea creativity) (Selart & Johansen, 2011; Deichmann, 2012; Bjork & Magnusson, 2009). Idea quantity could be defined as a number of ideas generated (MacCrimmon & Wagner, 1994; Korde & Paulus, 2016; Girotra & Ulrich, 2010; Deichmann, 2012). There is an additional variable chosen to research results – involvement or number of involved people (Dennis & Garfield, 2003; Deichmann, 2012). In this research, authors focus on idea quantity.

Methodology

Research instrument for measuring web-based IMS application results

A questionnaire was created for web-based IMS applied companies. The survey was conducted in the summer/autumn of 2018. Methods for obtaining primary data are described in Table 3. This survey results allowed to compile data on IMS in 8 blocks, according to Adaptive Structuration Theory: (1) type of IMS; (2) tasks; (3) organization system; (4) adaptation and type of use; (5) IMS results; (6) organisational effectiveness; (7) new structures; (8) problems with the use of IMS. Table 4 highlights the survey block - IMS results.

A total of 186 elements are summarized in 8 question blocks. In this paper, the applied survey block is IMS results. The questionnaire was created and distributed in English, as the dominant language of the IMS and its use in English. All criteria were based on literature analysis and updated scales were based on the results of the case studies as used to describe the results of the application of IMS.

Data collection

The survey was conducted on the survey platform 'The QuestBack' (https://www.unipark.com/) created by UNIPARK. This platform was chosen because it is: (1) focused on academic surveys; (2) widely recommended by world-class researchers; (3) provides data security required by IMS representatives – BSI-certified data centre in accordance with ISO 27001; (4) complies with the requirements of the EU General Data Protection Regulation.

To test the questionnaire, it was sent to 9 companies that conducted a survey and were able to comment on any question. The test was done in 3 rounds, the questionnaire was sent to 3 companies using the IMS when comments were received and based on the feedback the questionnaire was improved. In the third round, comments on the structure or clarity of the questions were no longer provided. Based on the tests, the time of completing the questionnaire was determined (20-30 minutes). After the test, the survey results were deleted.

It should be noted that to reach the target audience more accurately, the authors asked IMS developers to distribute the survey to their clients. It was stipulated that the survey should only be sent to companies using the system in question to the person in charge of the IMS (mostly think-tanks, innovation managers or business managers). In the authors’ private communication with 107 IMS
| Aim | Data selection | Data analysis | Period | Steps |
|-----|----------------|---------------|--------|-------|
| IMS application types impact on the results | Survey of the enterprises that applies web-based IMS (n>400) | Statistical analysis (frequency distribution, standard deviation, t-statistics, degrees of freedom (df), critical values (tc) and p-values, etc.) | 3rd quarter of 2018 | 1. Survey development based on literature analysis and developed classifications.  
2. Round survey test (data not included in the analysis).  
3. Survey distribution to 107 web-based IMS developers, that they could distribute to their clients.  
4. 400 valid surveys.  
5. Standard deviations to evaluate the data consistency for the analysis.  
6. Data analysis through selected methods |

Source: created by author's

### Table 3

| Question                                                                 | Scale           | Based on                                                                 |
|-------------------------------------------------------------------------|-----------------|--------------------------------------------------------------------------|
| Idea quantity - What is the average number of ideas created per task?   | None            | Based on the literature studies and empirical case studies conducted by the authors |
| Using internal IMS                                                      | To 10           |                                                                         |
| Using external IMS                                                     | 11 - 100        |                                                                         |
| Using mixed IMS                                                        | 101 - 1000      |                                                                         |
| Using active IMS                                                       | 1001 - 5000     |                                                                         |
| Using passive IMS                                                      | 5001 - 10 000   | More than 10 001                                                         |

Source: created by author's

developers and the information published by the IMS concerned, it was concluded that the IMS employs around 70,000 - 100,000 companies (derived from the average number of IMS clients).

Invitation for their system applicants to involve sent to 108 idea management system creators – Crowdcity, Viim, IdeasMine, Idea Drop, Ideanote, Receptive, CrowdWorx Innovation Engine, Ideawake, Sideways 6, OrganisedFeedback, Exago SMART, Ideation360, ProdPad, Vetter Online Suggestion Box, IdeaLab, GroupMap, Ideaflip, IDEAFOX, iMindQ, Innovation Cloud, innovation5g.com, MindView 7, WE THINKQ, eXo Platform, IdeaScale, HYPE Innovation, MindManager, Milanote, Innovation Platform, Kindling, Coggle, DataStation Innovation Cloud, SprintGround, Be-novative, BrainStorm, Idearium, Stormboard, MangoApps, Nova-Innovate Innovation Management Software, Wizeline, Comapping, FeatureMap, Glint Innovation, Ideacom, Mindomo, SoapBox, Spray, Wave, Work by InnoCentive, Braincatera, BrightSpars, Bubbl.us, CogniStreamer, De Idee Management Tool, e-Zassi, eyscrim, eVSM, Firefly, GainX, germ.io, Headstart, HiFiSH, Hives.co, id-Force, ID8 Enterprise, Ideabox, IdeaBridge, Ideafactory, Ideakeep, IdeaLinker Accelerate, Ideasbank, IDhall SC, Includer, INDONIS, Inno360, InnoEngines, innovabi, Innovation Agora, Innovation Central, InnovationCast, InnovationStation, Innovbook, ITONICS Ideation, MindApp, Nosco, NovaMind, Onyx Cloud Ideas, Orchidea, PIT, Postwaves, SocialJsIdeas, Solverboard, Sophia, TalkFreely, Verve, Vocool, Yambla, Accept360, Idea Glow, IdeaSpotlight, Idea Management Software by Planbox, Brightidea, IDEALYST, Online Suggestion Box, Flagpole, Spigit Idea Management Software, Academy of Ideas.

### Data analysis

To validate data for the further analysis the pre-analysis was conducted by using the following methods:

- Point estimation and interval estimation – “the process of providing a numerical value for a population parameter based on information collected from a sample. If a single figure is calculated for the unknown parameter, the process is called point estimation. The process of providing a
Findings

Basic data characteristics – idea quantity
Respondents frequency distribution based on survey data is shown in Figure 3.

![Graph showing frequency distribution of responses for idea quantity based on survey data.](image)

Source: created by author’s

The further detailed analysis consists of the arithmetic mean of the group, standard deviation, modal and medial class (group), coefficient of variation.

Arithmetic mean of grouped data is calculated as follows:

\[ \bar{x} = \frac{\sum_{i=1}^{k} f_i \cdot m_i}{n} \]  

where: \( m_i \) - \( i \)th class (group) midpoint, \( f_i \) - frequency of the \( i \)th class (interval), \( n \) - sample size, \( n = \sum f_i \).
The standard deviation of grouped data is calculated as follows:

$$s = \sqrt{\frac{\sum x_i^2}{n} - \left(\frac{\sum x_i}{n}\right)^2}$$ (2)

where: $$s^2 = \frac{1}{n-1}\sum f_i \cdot (m_i - \bar{x})^2$$, $$m_i$$ - ith class (group) midpoint.

The median (Me) of grouped data is calculated as follows:

$$Me = x_{Me,l} + \frac{(\frac{f_{Me}}{2} - cf_{Me-1}) \cdot \Delta Me}{f_{Me}}$$ (3)

where: $$x_{Me,l}$$ - lower class boundary of the interval containing the median, $$cf_{Me-1}$$ - cumulative frequency of the interval before the median interval, $$f_{Me}$$ - frequency of the median interval, $$\Delta Me$$ - the median interval width.

Medial interval is interval for which accumulated frequencies first time is equal or larger than half of the sample size.

Coefficient of variation (CV) is calculated as follows:

$$CV = \frac{s}{\bar{x}} \times 100\%$$ (4)

Point estimates were aggregated and are provided in Table 5.

| IMS type     | n | Mean    | Median   | S       | CV  |
|--------------|---|---------|----------|---------|-----|
| Active IMS   | 439| 4138,6  | 3392,1   | 3500,6  | 85% |
| Pasive IMS   | 306| 1141,1  | 96,7     | 2313,7  | 203%|
| Internal IMS | 411| 1284,3  | 396,1    | 2299,2  | 179%|
| External IMS | 371| 4377,1  | 3875,5   | 3543,5  | 81% |
| Mixed IMS    | 337| 4420,1  | 3842,6   | 3771,4  | 85% |

Source: Authors' constructions

As shown in Table 5, the medians for all IMS types are less than the means of the generated ideas. These differences indicate some asymmetry in the distribution of respondents - more often a smaller number of ideas are generated, but less often - a large number of ideas. There is a particularly large difference between these indicators for passive IMS as well as for internal IMS - as frequency distributions are skewed mean values does not give a good idea of a typical value that can be expected in case of using these types of IMS. The calculated coefficients of variation also indicate similar - passive and internal IMS has more variation, relative to its arithmetic means than other IMS application types.

Further described is the interval estimation for the population mean. The confidence interval for the population means $$\mu$$ is calculated as follows:

$$\bar{x} \pm ME$$ (5)

where: $$ME$$ - margin error.
As shown in Table 5, the medians for all IMS types are less than the means of the generated ideas. Mean values do not give a good idea of a typical value that can be expected in case of using these types of IMS. The calculated coefficients of variation also indicate similar - passive and internal IMS has more between these indicators for passive IMS as well as for internal IMS - as frequency distributions are skewed.

Coefficient of variation (CV) is calculated as follows:

\[ CV = \frac{s}{\bar{x}} \]

where \( s \) is the standard deviation and \( \bar{x} \) is the mean of the sample.

Confidence intervals (CI) provide the lower confidence limit (LCL) and the upper confidence limit (UCL) that are likely to contain the true parameter value (of the population). The value 95% refers to the probability that the interval will capture the parameter being estimated (Tan & Tan, 2010). 95% confidence interval estimates are aggregated in Table 6.

A 95% CI means that if the study will be conducted multiple times with corresponding 95% CI for the mean constructed, author’s expect 95% of these CI’s to contain the true population mean (Tan & Tan, 2010) and it could be between 3810 to 4467 ideas generated in active IMS, for passive IMS between 881 to 1401, for internal IMS between 1061 to 1507, external IMS between 4015 to 4739 and mixed IMS between 4016 to 4824.

Hypothesis testing – idea quantity

Basic data set analysis showed that it is possible to test the hypothesis on the gathered data. That is the reason why further in this paper the authors conduct significance tests for population mean number of ideas created (idea quantity). A respondent’s frequency distribution shows the main trends that will be tested: (1) active IMS provides higher idea quantity than passive IMS; (2) external IMS provides higher idea quantity than internal IMS; (3) mixed IMS provides higher idea quantity than internal and external IMS. See in Figure 8.

Hypothesis tested:

(H1) Active IMS provide higher idea quantity than passive:
\[ H_0: \bar{x}_{AC} - \bar{x}_{PC} \leq 0 \quad \text{and} \quad H_A: \bar{x}_{AC} - \bar{x}_{PC} > 0 \]

(H2) External IMS provide higher idea quantity than internal:
\[ H_0: \bar{x}_{EC} - \bar{x}_{IC} \leq 0 \quad \text{and} \quad H_A: \bar{x}_{EC} - \bar{x}_{IC} > 0 \]

(H3) Mixed IMS provide higher idea quantity than internal
\[ H_0: \bar{x}_{MC} - \bar{x}_{IC} \leq 0 \quad \text{and} \quad H_A: \bar{x}_{MC} - \bar{x}_{IC} > 0 \]

(H4) Mixed IMS provide higher idea quantity than external
\[ H_0: \bar{x}_{MC} - \bar{x}_{EC} \leq 0 \quad \text{and} \quad H_A: \bar{x}_{MC} - \bar{x}_{EC} > 0 \]
As sample sizes un standard deviations differs, the test statistics are calculated as follows, (Moore et al. 2016):

$$ t = \frac{\bar{x}_i - \bar{x}_j}{\sqrt{\frac{s_i^2}{n_i} + \frac{s_j^2}{n_j}}} $$(9)

where $\bar{x}_i$ and $\bar{x}_j$ means of comparable sample variables, $s_i^2$ and $s_j^2$ variance (standard deviation squared) of comparable samples variables, $n_i$ and $n_j$ sample sizes of comparable samples and compared with $t$-statistics critical values $t_{c}$, where degrees of freedom (df) for the $t$-test statistics are calculated as follows:

$$ df = \frac{\left[\frac{s_i^2}{n_i} + \frac{s_j^2}{n_j}\right]^2}{\frac{(s_i^2)^2}{(n_i-1)} + \frac{(s_j^2)^2}{(n_j-1)}} $$(10)

Also, $p$-values were calculated for given test statistics and the degrees of freedom. The $p$-value is the probability of obtaining a value of the test statistic as extreme as or more extreme than the actual value obtained when the null hypothesis is true. Thus, the $p$-value is the smallest significance level at which a null hypothesis can be rejected, given the observed sample statistic. Calculated $t$-statistics, degrees of freedom (df), critical values ($t_{c}$) and $p$-values are aggregated in following Table 7.
Table 7
Hypothesis test statistics for idea quantity

| Pairs tested       | t    | df     | tc  | p-value |
|--------------------|------|--------|-----|---------|
| AIMS vs PIMS       | 14.07| 741.05 | 1.96| <0.0001 |
| IIMS vs EIMS       | 14.31| 623.41 | 1.96| <0.0001 |
| IIMS vs MIMS       | 13.36| 531.54 | 1.96| <0.0001 |
| EIMS vs MIMS       | 0.16 | 688.74 | 1.96| >0.05   |

Source: created by author’s

From test results, authors would reject the null hypothesis 1, 2, 3 and conclude that sample data provide strong evidence to support conclusions that:

- (H1) Active IMS provide higher idea quantity than passive;
- (H2) External IMS provide higher idea quantity than internal;
- (H3) Mixed IMS provide higher idea quantity than internal.

These conclusions are supported by very low p-values (<0.0001).

Regarding H4 authors cannot reject the null hypothesis because t < tc and p-value >0.05 – so sample data does not give sufficient evidence that mixed IMS provide higher idea quantity than external.

Conclusions

There is strong statistical evidence to support conclusions that:

- Active IMS provide higher idea quantity than passive.
- External IMS provide higher idea quantity than internal.
- Mixed IMS provide higher idea quantity than internal.
- Paper does not have sufficient evidence that mixed IMS provide higher idea quantity than external.

This research fulfils an identified need to clarify IMS types and their impact on the results – idea quantity. This research delivers the following academical contribution:

1. it is the widest web-based IMS empirical research based on the survey;
2. approbated classifications of IMS;
3. it researches different classifications of IMS and their impact on idea quantity.

The practical contribution of the research results helps to understand what kind of results enterprises could expect from different IMS application types.

Research results highlight the benefits/implications of adopting different types of IMS for organizations. These contributions also provide managers with a richer set of theoretical tools, enabling them to make better decisions regarding the selection of IMS that are the best for achieving the results in the given context. Web-based IMS types and their impact on the IMS results could help to evaluate the potential application of these systems in different application scenarios.

This research concentrated only on commercially available web-based IMS, but further research could include insights from non-commercially/private IMS, as well as real-life IMS. Additional research should be done to compare real-life and web-based IMS. Also, detailed research is needed to explore why standard deviations and coefficient of variations are so high.

Further research should provide evidence on what benefits the different classes of IMS provide to organizations and also on other IMS results, such as, idea quality and involvement. This also coincides with van den Ende et. al. (2015) call to research different IMS types and their results. The research delivered by authors is the first attempt to answer this question, but there are a lot of additional questions to be answered. The authors are convinced that this paper will attract the interest of more researchers regarding IMS types and their impact on its results.
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