6. DISCUSSION & CONCLUSION

The analysis and discussion of results of this research were comprehensively presented in the previous chapter. It is important that the research is summarized, findings are reviewed and interpreted and its contribution analyzed. Also, the limitations and scope for future research must be stated. This chapter is the last chapter of the main thesis and is divided into six sections. The first section provides a brief summary of the research. The second section provides a comprehensive review of the research findings along with the interpretation of results for the two classes of hypothesis – direct effects and mediation effects. Findings and interpretation of triangulation are also summarized. The third section is a revisit of the research objectives and research questions and the inferences based on the results. The fourth section outlines the contribution of this research and its implications both for academia (research) as well as industry (practice). The fifth section highlights the limitations of this research. The sixth and final section makes an attempt to provide the directions for future research that could further augment the value of this empirical study.

6.1 Summary of Research

In line with the objective of this study, the scope of work was to seek specific answers to research questions relating to relationships between the various constructs of EA, RC and Performance (PV) and bridge the current gaps resulting from focus of EA studies primarily on private sector, largely anecdotal and case study researches, mostly dealing with implementation lifecycle, and lack of relevant and comprehensive public value assessment models. Since EA adoption has also meant significant government spending, it was important to take stock of the
impact, as well as provide a mechanism to similar organizations to understand the significance of enabling resource capabilities, and a framework to measure the impact. This will be of value to the organizations implementing EA in future particularly for public sector and government organizations.

In order to address the research questions and test specific hypotheses, an empirical survey was conducted covering the target population of 175 organizations, post the literature survey and finalizations of constructs through field interactions. Responses were sought from the IT and business heads of each of these organizations. Finally, 110 valid responses from 55 organizations were obtained and analyzed. Reliability and validity of constructs, and other prerequisites were met prior to multiple regression analysis to test the two classes of hypotheses: (1) direct effects of EA on performance, RC on performance and EA on RC; and (2) mediation effects of RC (tangible and intangible resources) between EA and performance. Additionally, Productivity ratios of 27 of these organizations were also analyzed to test any significant difference before and after EA implementation, for triangulating the results.

6.2 Review of major Research Findings

As described in Chapter 5, the study found initial support for the reliability and validity of the items considered for this research. In cases of low “item to total correlations”, the items were dropped to improve reliability of measures. Content validity was considered on the basis of literature findings and expert validations. Subsequent construct validity was established using exploratory factor analysis and the process ensured identification of constructs that explained a very high percentage (upwards of 72%) of the studied dimensions, viz., EA, RC and
Performance (PV). These constructs were also found to be reliable for further analysis. In case of each of the dimensions, most items loaded as expected and all of the factors/constructs empirically existed as prescribed by theory. One modification that was made at this stage was to consider “Tangible Resources” and “Intangible Resources” as the constructs of Resource Capability as against the constructs identified initially from literature. This modification based on empirical results was still reliable and valid and, in fact, content/face validity is found in the literature. This ensured usage of the resource capability constructs as per empirical results in order to ensure higher construct validity in the subsequent analysis and results. While the validity has been clearly established for the constructs of this study, additional and more rigorous assessments of discriminant and convergent validity should be undertaken by future research to more completely establish the validity of the items.

As was discussed in Chapter 5, empirical support was found for nearly all of the research hypotheses. Specifically, it was found that the constructs of enterprise applications (EA), viz., Classic EA and Productivity EA, were positively related to all the constructs of performance, viz., Service; Productivity; and Political Consideration & Financial Productivity. New EA (CRM, SRM etc.), however, did not show any significant relationship with the performance measures. In terms of the association between resource capability (RC) created due to EA and Performance, tangible resources (physical infrastructure and number of people) did not exhibit any significant relationship with the performance constructs. Intangible resources (BPR, understanding, alignment) on the other hand showed a very strong and significant association with respect to performance of the organization. The analysis of relationship between the constructs of EA and RC showed significant models but the variance explained between EA and tangible resources was weak. Intangible resources showed a much stronger and significant
relationship with respect to EA constructs and other than New EA, the two constructs, viz., Classic EA and Productivity EA, had significant positive association with intangible resources impacted by implementation of EA.

For the analysis of mediation by RC constructs between EA and Performance, hierarchical regression analysis and testing of mediation using Sobel Test was used as the methodology. This analysis was consistent with the results of the analysis of direct effects outlined earlier. Since tangible resources had little role to play in impacting performance (as shown in the analysis of direct effects), it also did not mediate the relationship between EA and performance measures. It was concluded that only intangible resources mediated the relationships between EA and performance of public sector and government organizations.

As triangulation approach was also taken up as a part of the research to enrich our understanding of the association between EA and Productivity dimension of Performance, the paired sample T-Test of the mean productivity ratios before and after implementation of EA was analyzed. The T-Test very clearly triangulated the results from the empirical research showing a statistically significant difference in the productivity after implementation of EA particularly with respect to employee, debtors and inventory productivity.

4.1 Interpretation of Direct Effects

First, it was found that Classic EA (ERP) and Productivity EA (BI and Productivity Apps) had significant and positive association with all the constructs of performance, viz., Service; Productivity and Political Consideration & Financial Productivity respectively. Collectively, the results supported the overall hypothesis of a significant impact of EA on Performance of public sector and government organizations. However, the New EA (CRM, SRM, and Specialized
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(ps) did not show any significant association to Performance. The results are in line with the phenomenon of public sector and government organizations being late adopters (Harris, 2004) of EA wherein New EA have either been implemented in a very limited manner or have not yielded significant results due to complexity of its implementation and usage.

Second, the analysis of association between RC and Performance clearly indicates that tangible resources (physical infrastructure and number of people) created as a result of EA implementation has a little role to play in impacting performance. On the other hand, it is the intangible resources (BPR, understanding, alignment and IT capability) that have a significant and strong association with performance. This result is in line with a few case studies of public sector organizations that were conducted independently during the course of this research (Niraj Pathak et al., 2013). The RBV theory, which states that valuable resources that are neither perfectly imitable nor substitutable without great effort (Hoopes et al., 2003; Raphael & Schoemaker, 1993; Barney, 1991) are key to firm’s bundle of resources that can assist in sustaining above average returns, is implicit in the results of the empirical results from this study.

Third, while the EA to RC models were significant, the association between EA and tangible resources was weak. This was also a validation of the observations from case studies of public sector and government organizations which have not added significantly to non-IT physical infrastructure and number of people in the organizations. They have largely leveraged on existing physical infrastructure and redeployment of their existing staff resources for managing the EA implementations. Intangible resources, on the other hand, have gone through significant changes/improvements as a result of EA implementation and this is evident in the results of this empirical research and the hypothesis related to EA and intangible resources.
2.2 Interpretation of Mediation Effects

The results of the analysis of mediation showed that only intangible resources mediated the relationships between EA and performance of public sector and government organizations. This was in line with the direct effect results which showed an insignificant role of tangible resources impacting performance or getting impacted itself as a result of EA implementation.

First, the analysis of tangible resources as the mediator was done with respect to EA and different constructs of performance in three different hierarchical regression models. While tangible resources were found to have significant to marginally insignificant beta coefficients, it did not survive the subsequent test of significance for the mediation effect (Sobel, 1982). Hence, it was concluded that tangible resources do not mediate the relationship between EA implementation and Performance. This is evident as we have seen from earlier interpretations that tangible resources neither got enhanced from EA implementation nor did they matter so much for enhancing performance of public sector and government organizations.

Second, the analysis of intangible resources as the mediator was done with respect to EA and different constructs of performance in three different hierarchical regression models. Intangible resources were found to have significant and substantive beta coefficients and the test of significance for mediation further showed that the quantum of mediation effect was significant within the defined confidence level. This implies a significant mediation of intangible resources between implementation of enterprise applications and performance of public sector and government organizations. Indeed, it is critical to augment the intangible resources (because they are unique and inimitable) in order to get a sustainable competitive advantage as per the theory of RBV that has been elucidated earlier in this work. This result also has a significant implication.
for implementing organizations wherein they should focus on augmentation of intangible resources and capabilities to get the best out of their IT investments in general and EA implementation in particular.

6.2.3 Interpretation of Triangulation Results

Triangulation in research refers to the use of multiple techniques for gathering and/or handling data within a single study. The purpose of triangulation is to seek additional confirmation of findings. For the purposes of this research a partial approach to triangulation was taken to seek confirmation on hypotheses related to impact of EA on productivity of public sector and government organizations. This was done by taking the mean productivity ratios of organizations for which Financial Statements were available in their Annual Reports. Five productivity ratios, viz., Debtors’ Turnover, Inventory Turnover, Asset Turnover, CWIP Turnover and Employee Productivity were computed for the “before” and “after” EA implementation periods and were subjected to a paired sample T-Test for any significant change. The results have shown a significant improvement for three of the five ratios. Debtors’ Turnover, Inventory Turnover and Employee Productivity showed significant improvements whereas Asset Turnover and CWIP Turnover changes were not significant at 95% confidence interval. The results partially validate the hypotheses that were supported for productivity impact. The improvements in the current asset productivity ratios and employee productivity are in line with the expectation of EA impacting these in the short term. The fixed asset and CWIP productivity ratios did not see significant change as the period over which they are expected to change will be longer than the period considered for this analysis.
Revisiting Research Objectives and Research Questions

Before one attempts to articulate the contributions of this research, it is important that the objective of the research and the research questions are reviewed in order to assess the extent to which the research has fulfilled the expectations.

Just to reiterate, this empirical research fulfills the key objective of measuring the impact of enterprise applications on the performance of public sector and government organizations. It has helped in understanding the impact on performance through value creation with respect to service, productivity and political consideration dimensions. It also fulfills the objective of validating the assertion of RBV theory by concluding that intangible resources (which are unique and inimitable) indeed are significant for achieving sustainable advantage. This is demonstrated through the mediation that these resources have shown between EA and Performance. Additionally, in the process of this research, it has also served the objective of conceptualizing and specifying stable and valid constructs of resource capability and public value (measuring performance).

This study also answers the research questions envisaged at the start of the study. Table 6.1 is a summary of the research questions and the generalized inferences that are drawn from the results obtained in this research.
### Table 6.1: Research Questions and Inferences

<table>
<thead>
<tr>
<th></th>
<th>Research Questions</th>
<th>Inferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Does the adoption of enterprise applications impact the performance of public sector and government organizations?</td>
<td>Yes. Classic EA and Productivity EA have significant impact</td>
</tr>
<tr>
<td>2</td>
<td>What is the impact of enhancement of resource capabilities on the performance of public sector and government organizations?</td>
<td>Intangible Resources alone impact the performance significantly</td>
</tr>
<tr>
<td>3</td>
<td>What is the impact of adoption of enterprise applications on resource capabilities of public sector and government organizations?</td>
<td>There is a positive association between EA and RC. However, EA has stronger positive association with intangible resources</td>
</tr>
<tr>
<td>4</td>
<td>Does resource capability mediate the relationship between enterprise applications and the performance of public sector and government organizations?</td>
<td>Yes. But, only the intangible resources mediate the relationship between EA and Performance significantly.</td>
</tr>
<tr>
<td>5</td>
<td>How can resource capability and performance be defined in the context of enterprise applications in public sector and government organizations?</td>
<td>Research Model has enumerated both the initial as well as final constructs</td>
</tr>
</tbody>
</table>

### Contributions of Research and its Implications

While this study addresses the key objectives and provides general inferences and specific answers to various research questions, it is important to highlight the key contributions of this research. This research would not be useful unless it makes a few specific contributions to both academia as well as to the practices in the industry in general and public sector and
government organizations in particular. In fact, this research makes a number of contributions with implications for both theory and practice.

4.1 Key Contributions and implications for Academia and Research

From the perspective of the body of EA research, this study provides significant contributions to the conceptual development of the EA and RC constructs and theoretical understanding of the relationships between EA, RC and Performance including how the resource capability constructs mediate the relationship between enterprise application and performance. Importantly, the conceptual development of the performance measures highlighting the concept of public value in the context of public sector and government organizations is a substantial contribution (Prakash, et al., 2008).

4.1.1 Conceptual/Measurement Development

This study provides for conceptual development in three areas. First, the enterprise applications dimensions are logically defined into multi-factor constructs that enriches the understanding of different types of enterprise applications and their relevance and usage. Second, resource capability typologies are used to arrive at a literature based set of constructs which is further refined empirically. Third, and perhaps the more complex, conceptual development was that of a multi-dimensional framework for public value that can be used for measuring performance in the context of public sector and government organizations. While this framework is used in this research specifically in the context of enterprise applications, the measures would be found to be equally reliable and valid in the context of other IT/IS researches on public sector and government as well. This is also exhaustive as the measurement of performance embodies learnings from several researches across multiple performance related domains both in the public
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in private sectors, but at the same time maintaining relevance for public sector and government organizations. The study ensures a statistically sound mechanism to operationalize the construct and hence it would be useful to use them in future researches as well. It was demonstrated that the measures and constructs exhibited acceptable levels of reliability and construct validity. This has been demonstrated both from the perspective of the validation from practitioners that was demonstrated throughout the process of developing the measures and also the reliability assessments and factor analyses that were made as a part of data analysis. Certainly, this makes for a significant contribution to multiple domains of research – IT/IS/EA, resource based view and public value.

6.4.1.2 Theory Building and Empirical Testing

Additional contributions are made by this research by building a potential model of relationships between enterprise applications, resource capabilities and performance as measured by public value. This is very useful as most researches in the past have focused on direct relationships. Indeed, it is the examination of the underlying mediation effect that is significant to understand the process by which performance and value is generated. The model proposes the mediation role that RC plays between EA and Performance. This is grounded in the theory of RBV for sustainable competitive advantage. The empirical results show a strong mediation of intangible resources and capabilities in order to achieve a significant impact on the performance of organizations. Measures such as BPR, improved understanding, better alignment to job functions and enhancement of IT capabilities are shown to be significant areas that can help achieve higher chances of positive impact of IS/IT on performance of organizations. This in itself could be a matter of further detailed exploration. Besides, the methodology for empirical testing of mediation used in this research is founded on the method of hierarchical regression and
significant changes due to mediation and testing for the significance of quantum of mediation. While there is a potential for using more advanced techniques to determine such underlying inter-relationships, it is not always that large data sets are available for complex analysis. To that extent, the methodology used here provides useful mechanism for testing such mediation hypotheses. This is also a useful contribution in empirical testing.

4.2 Key Contributions and implications for Industry and Practice

Just as the research holds important implications for the academia, it also creates significant contributions for the industry and practitioners. These contributions can be classified into those that improve the practitioners’ understanding of EA implementation and those that relate to how conceptual measures can aid the practitioners and implementers.

4.2.1 Implementation Practices

This research clearly brings out the results of EA implementation on the performance of public sector and government organizations. Additionally, it also provides the inter-relationships with source capability enhancements that underlie the success and positive impact of EA implementation. This then can be very useful for the practitioner to understand the areas of focus while investing in and implementing EA. Usually, EA implementation is a large investment both in terms of time and resources and it is useful to have guidance on critical factors that will ensure success. If the results of this research were to be generalized, it is evident that practitioners need focus on enhancement of resource capabilities, particularly the intangible ones, in order to see significant impact on the long term performance of the organization. While EA enhances performance, it does so through the underlying enhancement of intangible resources and
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abilities. The other result was in terms of the impact of Classic EA and Productivity EA on performance being stronger and significant as opposed to New EA such as CRM, SRM and specialized Apps. The contribution here is in terms of this insight suggesting further investigation into this phenomenon. It has been generally observed that implementation and usage of New EA is relatively more complex and, hence, organizations envisaging implementation of such applications must ensure adequate support and focus on these areas.

4.2.2 Conceptual Frameworks for Industry

A big contribution of this research is in the area of providing the industry and practitioners a comprehensive framework of constructs that can be leveraged while implementing EA as well as measuring the impact of their investments on EA. Academic research needs to make a strong case for its relevance for the industry. This study particularly provides for this on two counts. One, it provides a model to the industry to understand the relationships between key constructs of EA implementation which can also be extended to any type of IS/IT implementation. Two, it provides a measurement framework to the practitioners in the public sector and government organizations to assess the impact of their EA implementation on performance and overall public value. This again is equally extensible framework for other types of IS/IT implementation as well. This is a very significant contribution as the practitioners now have a reliable and valid tool tested through this empirical research to address very important questions around IS/IT/EA investments and its impact on overall public value.
6 Limitations of Research

As with most studies, there are some limitations of this study that should be examined. These limitations can be categorized in four areas.

First set of limitations relate to the identification of measures. While best attempts were made to identify the key measures/items from the literature and through experts, the literature defining EA was found to be limiting in terms of exhaustiveness of items to be considered for research. Hence, the researcher had to depend a lot on his own understanding of the domain and other expert opinion to formulate the final set of items. This may have resulted in a slightly narrow view of EA.

Very importantly, as shown by several IS/IT studies, the “Use” of the EA system (as against its “implementation”) alone can impact the performance. While care has been taken in this study to consider only those organizations which have “Used” EA for 2 years or more (in fact, 64% of the observed/analyzed data have shown period of usage upwards of 4 years as indicated in Table 62), the study may have been limited by not making hypotheses decisions based on the differences in impact on performance due to varying “period of usage”. For the scope of this study, assimilation is assumed to be achieved after its use for at least 2 years of the specific product release that was initially implemented. The study, however, does provide the ANOVA for testing the significance of “period of use” (as a control variable) on the EA, RC and PV constructs. These results are provided in section 5.1 of Chapter 5. Additionally, it may be noted that assimilation of EA in an organization, and hence the measurement of its impact on performance, is a “moving target” due to introduction of new releases and upgrades of EA that
the organization may have taken up. Any significant difference on performance due to such perpetual cycle of upgrades and new releases are beyond the scope of this study.

The second set of limitations relate to the sample. While the researcher is confident that all the public sector and government organizations in India which have implemented one or more EA were reached out to provide responses, it is possible that some organizations may have been missed. There is no authentic published list of such organizations and the researcher had to rely on the information available from EA vendors and other multiple sources including his own knowledge and experience in this industry. This makes the sample lean towards being slightly purposive than being completely random. The additional limitation with respect to the sample could come from undetected response bias as the respondents can be expected to respond more positively than reality to ensure they project the implementations and its impact on performance in good light. This bias, however, is not expected to alter the results significantly as multiple respondents have been covered from each of the organizations in the sample.

Third set of limitations pertain to the research methodology. While face validity and construct validity have been fully established for the purposes of this study, a more rigorous methodology for discriminant and convergent validity could make the measures even more powerful. The current methodology, however, fulfills the objective of the current research and this could be the subject of future research with much larger set of items. Also, since the expertise in this domain (both EA and Public Sector & Government) is very limited, the focus groups and expert validations had to do with lesser number of people than desired for a robust focus group methodology for the development of measures. This, in turn, could have resulted in limiting the set of measures used for this research and hence slightly weaker power of the associations. For the purposes of this research, though, this should not matter significantly as the objective was to
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of associations and relationships and not make predictions. The results suffice for making generalizations with respect to inter-relationships between different dimensions of this study. Lastly, with respect to methodology, more complex methods such as Structural Equation Modeling (SEM) could be a good fit for testing all associations and relationships simultaneously.

However, as per Malhotra, Naresh K. (2010), when there are more than five constructs, with several constructs being measured with fewer than three indicators, and there are multiple low (less than 0.5) communalities, the sample size should be at least 400. In any case, sample size should be generally in the range of 200 to 400, subject to other considerations. For the purposes of this study wherein, even though the communalities are high, the number of constructs were 8 and many measured with fewer than three indicators. Any sample of less than 300 observations would not have yielded stable, reliable and generalizable results. This was comprehensively discussed with relevant SEM experts also and was consciously dropped as the method of analyzing the interacting relationships and complex measurements even though, theoretically, SEM is stated as another alternative (and perhaps superior) methodology. Large data sets were not possible in this study/domain currently due to the population of overall implementations (approximately 175) and the difficulty of obtaining responses from public sector and government organizations.

Finally, the fourth set of limitation is with respect to the results. In few of the regression models, the coefficient of determination (R$^2$) exhibits weaker power which will not be sufficient for predictions based on these models. However, for the purposes of this research which only explores relationships and associations amongst the dimensions under study and does not aim to predict based on these models, it is possible to generalize on the basis of the results. It may be noted that coefficient of determination is usually found to be on lower side for cross-sectional
data compared to time-series data. Research also indicates that the metric $R^2$ is unreliable in the presence of scale effects and it is invalid to make between sample comparisons of $R^2$ (Brown, Stephen et al, 1998). Also, since the focus of the research was on specific impact of EA on Performance, there are other items impacting Performance that the respondents are unable to separate while responding to the questionnaire (Karen Grace-Martin, 2013). Keeping this context, the results of association can be generalized if the models are statistically significant.

6.6 Directions for Future Research

There are two categories of research directions that the researcher would recommend. One, which enhances the quality of this research by overcoming some of the limitations outlined earlier and, Two, by enhancing the coverage of the Model itself.

On the first one, the key next steps could be adding larger number of items, obtaining larger number of end-user responses, testing for discriminant and convergent validity and using SEM as the methodology if large data sets can be obtained. These measures would result in a significant improvisation over the current research.

In terms of enhancing the richness of the Model coverage, the recommendations are: (1) to examine the reasons for New EA having insignificant impact on Performance; (2) to examine reasons for Tangible Resources not mediating the relationship between EA and Performance; (3) Independently enhance the framework for resource capability through empirical research; (4) Independently enhance the framework for public value through empirical research; (5) Add the usage dimension to the performance assessment since it is very important that the systems are used comprehensively for it to be of value and ANOVA tests in this study show partially
significant differences in impact due to varying “period of use”; (6) Work with longitudinal data across organizations to assess the impact of time-periods and upgrades and/or implementation of new releases; and (7) Take up separate studies for government and PSUs even though the independent sample t-test for the data in this study did not show a significant difference, as it is generally believed that the two are different in their capabilities towards adoption of IT/IS, and hence EA, systems.

The above mentioned future research is obviously not possible in a single study and can be undertaken by both the academic fraternity and industry practitioners over a period of time to augment the current state of understanding and knowledge in the area of EA implementations in general and public sector and government organizations in particular.