Journal of International Technology and Information Management

Volume 22 | Issue 2 Article 3

11-1-2013

Effect of Virtualization on Enterprise Network, Server/Desktop Systems on Small and Mid-Size Businesses (SMB)

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ABSTRACT

Enterprise small and mid-size businesses (SMB) are embracing virtualization because of the need to reduce risks associated to IT outages and data loss. Most of these establishments have loss critical enterprise data due to systems failures, accidents or natural causes. Virtualization platforms increase application availability which can shorten disaster recovery time and improve SMBs business continuity preparedness. This study will explore these benefits to find critical issues that can enable SMBs to maintain competiveness by utilizing less to do more.

INTRODUCTION

Enterprise network infrastructure has profoundly impacted information systems business world. As small, mid-size businesses, various devices and data move beyond the traditional security of the corporate landscape, cyber-attacks will continue to grow at an exponential proportion. In 2012, network security gurus experienced cyber dangers ranging from sophisticated advanced persistent threats, to firewire attacks, to lost or stolen laptop.

Enterprise network's mobile endpoints are literally moving targets and until they are adequately secured against attacks, enterprise business intelligence, reputation or competitiveness are at risk

The goal of this article included the following:

1. To identify the extent mid- size organizations have adopted or planned to adopt virtualization technology in 2012.
2. Identify potential barriers that cause enterprise systems to postpone or decide not to adopt virtualization.
3. Identify among adopting firms, what virtualization products are most popular and which applications are most commonly virtualized?
4. Identify the core drivers that cause enterprise systems to be virtualized.

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

LITERATURE REVIEW

Berde et al. (2009) among others noted that virtualization is not a perfect solution to how organizations manage their resources but concluded that this technology provides tremendous capabilities on how enterprise systems manage and move operating systems into different hardware resources. Grid computing evolved as an innovative technology, and is distinguished from traditional distributed networks because of its large-scale resource sharing capabilities. The author further explained that grid computing allows large numbers of hardware components to act as a single device, thereby, pooling their capacity and re-allocating these components to different jobs.

Ercan (2010) argued that "in the next generation of Grids, applications will not necessarily be designed to run on certain piece of hardware or network, but will be written to consume certain types of resources, which could be provided anywhere on the network. He further summarized that to accomplish this, enterprise systems and technical gurus need more dynamic networks than are at the present time in existence. However, noted that virtualization efforts in the networking community are already moving the industry in that direction".

Fiedler and Gallenkamp (2008), in their study reviled that virtualized infrastructure provides a layer of abstraction between computing storage, networking hardware, and the applications running on it. Their study further explained that the deployment of virtual infrastructure is non-disruptive to the system, because the user experiences are typically un-noticed or unchanged. The authors concludes by emphasizing that virtual infrastructure provide enterprise system management, the opportunity to manage pooled resources across the enterprise, thereby, allowing Information Technology (IT) managers to be more responsive to dynamic system needs to better leverage infrastructure investments.

Early studies by Burry et al. (2004), Brandel (2004), Cannor (2005), found evidence that virtualization has been a part of the IT landscape for decades but today vendors are now conveying remuneration to industry-standard X86-based platforms which now encompass the preponderance of desktops, laptops and server shipments. They concluded by stating that a major benefit of virtualization is in the ability of systems to run multiple operating systems on a single physical system while sharing the underlying hardware resources or partitioning. More recent studies have concluded that virtualization can apply to a range of system layers, including hardware-level virtualization, operating system- level virtualization, and high-level language virtual machines (Morana et al., 2011; Seyler et al., 2011; Tusa & Mikkilinemi, 2011) .

According to Rudolph (2009) "Virtualization does two things tremendously well.

> *It allows an enterprise system to run multiple workloads on a single machine with great isolation between those workloads. By providing this hardware-level abstraction and strong isolation between multiple host operating systems, if one workload crashes, the other can continue to run unobstructed.*
>
> *It's also great at suspending, resuming and migrating images around an IT environment, in run-time. Without even shutting down an image, you can move jobs to new machines without any sort of disruption in performance."*

METHODOLOGY

Survey Questions and Descriptive Statistics

In order to pilot test the questionnaire (see Table 1), the authors constructed, distributed and collected the survey questionnaires at an Information Technology professional conference in April 2012 at San Antonio Texas. These professional who are experts in their respective fields of IT comprise of mid-market of 100 to 999 employees and enterprise-class of 1000 > employees. The survey questionnaires were distributed to 1,574 attendees. The number completed and returned was 161. Overall, we consider this was an equitable representative random population. Most of the survey items were yes/no responses or categorical or ordinal items (making them amenable to statistical tests), and a few questions were pertaining to gender.

Table 1: The survey questions.

1	Select Gender Male = 1; Female = 2
2	Which applications do your firm have running in virtual production environment
3	How strongly do you agree to the effectiveness of the virtualization of your organization?
4	Which team in your organization is driving server virtualization, network or other virtualization projects
5	What is your firm's core business results anticipated to achieve at deploying server virtualization technology [reasons for virtualization]
6	What type of virtualization does your firm currently have or will deploy in 2012
7	Are network issues a barrier for adopting server virtualization?
8	Are scalability issues a barrier for adopting server virtualization?
9	Is application performance a barrier for adopting server virtualization?
10	Can budgetary issues be a barrier for adopting server virtualization?

FINDINGS

As new technologies have evolved, enterprise systems have moved from initial proof-of-concept deployment to full-scale, global production deployment. Virtualization technology enables enterprise systems to improve server utilization thereby reducing capital and operating expenses. In order to explore the benefits of virtualized environment to small and mid-size businesses, this survey addressed the following questions:

> To identify the extent mid- sized organizations have adopted or planned to adopt virtualization technology in 2012.

An analysis of the data showed that 73% of the respondents agreed that virtualization was very effective or extremely effective in their organization. Less than 4% thought otherwise. However, when the results are broken down by gender, the results are slightly different. 74% of the male respondents agreed that virtualization was very effective or extremely effective in their organization, while only 2% thought otherwise. In the case of female respondents, 73% agreed that virtualization was very effective or extremely effective in their organization, while 5% thought otherwise. These results show that there is no significant difference between the perspectives of male and female respondents.

Table 2: How Strongly do you agree to the effectiveness of the virtualization of your organization?

V3, ALL		Frequency	Percent	Valid Percent	
Valid	Extremely Effective	44	27.3	27.3	27.3
	Very Effective	74	46.0	46.0	73.3
	Hard to Decide	37	23.0	23.0	96.3
	Not Effective	6	3.7	3.7	100.0
	Total	161	100.0	100.0	

Table 3: Which team in your organization is driving server virtualization, network or other virtualization projects?

V4, ALL		Frequency	Percent	Valid Percent	
Valid	Systems Server Team	59	36.6	36.6	36.6
	QA Team	6	3.7	3.7	40.4
	Application Team	26	16.1	16.1	56.5
	Network Team	70	43.5	43.5	100.0
	Total	161	100.0	100.0	

Overall, the dominant driving force behind server virtualization and other virtualization projects is the Network Team. 43% of the respondents identified the Network Team as the dominant driving force behind their organization's virtualization. This is closely followed by the Systems Server Team (37%). Between these two teams, over 80% of the respondents are driven by either the Network Team or the Systems Server Team. Broken down by gender, we find that 50% of the male respondents identified the Network Team as the dominant driving force behind their organization's virtualization, followed by the 32% that identified the Systems Server Team as the driving force behind server virtualization. From the female perspective, 41% identified the Systems Server Team as the dominant driving force behind their organization's virtualization, followed by 36% who identified the Network Team as the driving force. In other words, 77% of the female respondents identified either the Network Team or the Systems Server Team as the dominant driving force behind their organization's virtualization.

Identify potential barriers that cause enterprise systems to postpone or decide not to adopt virtualization.

Most respondents ranked Network Issus as the biggest potential barrier that causes systems to postpone and not adopt virtualization; and there is no significant difference in the responses between male and female respondents. Overall, respondents ranked scalability as the least likely barrier to adopting virtualization.

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

Table 4: Network issues.

Variable	All Respondents	Male Respondents	Female Respondents
V7	85	80	90
V8	58	56	60
V9	82	81	83
V10	72	76	68

Identify among adopting firms, what virtualization products are most popular and which applications are most commonly virtualized? Which Applications does your firm have running in a Virtual Production Environment (see Table 5).

Table 5: Virtual production environment.

		Frequency	Percent	Valid Percent	
Valid	Open Source Applications	13	8.1	8.1	8.1
	In-House Applications	30	18.6	18.6	26.7
	Microsoft SQL Server	57	35.4	35.4	62.1
	Microsoft Exchange Server	56	34.8	34.8	96.9
	Others	5	3.1	3.1	100.0
	Total	161	100.0	100.0	

More than 70% of all the respondents have Microsoft Exchange Server or Microsoft SQL Server running in a virtual Production Environment, and less than 20% use in-house applications, and less than 10% use open source Applications. The distribution is not different when we filter out both male and female respondents.

What type of virtualization does your firm currently have or will deploy in 2012?

Table 6: Server valid.

		Frequency	Percent	Valid Percent	
Valid	Server Virtualization	83	51.6	51.6	51.6
	Storage Virtualization	17	10.6	10.6	62.1
	Network Virtualization	47	29.2	29.2	91.3
	Microsoft Exchange Server	14	8.7	8.7	100.0
	Total	161	100.0	100.0	

Over half of the respondents deployed server virtualization in 2012, while 29% deployed Network virtualization in the same time period.

What are the core drivers that cause enterprise systems to be virtualized?

Table 7: Manageability of servers.

		Frequency	Percent	Valid Percent	
Valid	Improved Manageability	14	8.7	8.7	8.7
	Server Consolidation	76	47.2	47.2	55.9
	Faster Application	28	17.4	17.4	73.3
	Reduce power & space requirements	43	26.7	26.7	100.0
	Total	161	100.0	100.0	

Almost half of the respondents considered Server Consolidation as their reason for virtualization. The second most important reason is Reduction of power and space requirements. There is no difference between male and female respondents.

How strong are the correlations between V2 to V6?

Table 8: Correlation Matrix.

		v2	v3	v4	v5	v6
v2	Pearson Correlation	1	-.049	-.203**	-.202*	-.003
	Sig. (2-tailed)		.536	.010	.010	.970
	N	161	161	161	161	161
v3	Pearson Correlation	-.049	1	.038	.102	-.027
	Sig. (2-tailed)	.536		.632	.197	.735
	N	161	161	161	161	161
v4	Pearson Correlation	-.203**	.038	1	.064	.044
	Sig. (2-tailed)	.010	.632		.419	.578
	N	161	161	161	161	161
v5	Pearson Correlation	-.202*	.102	.064	1	-.084
	Sig. (2-tailed)	.010	.197	.419		.292
	N	161	161	161	161	161
v6	Pearson Correlation	-.003	-.027	.044	-.084	1
	Sig. (2-tailed)	.970	.735	.578	.292	
	N	161	161	161	161	161

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

The correlation matrix shows that there is a strong positive correlation between variable 2 and variables 4 and 5. In other words, respondents who tend to have Microsoft Exchange Servers running in their production environment are more likely to be driven by the Network Team. Also, firms that have Power reduction and space requirements as their reasons for virtualization are more likely to be running Microsoft Exchange Server Applications in their production environment. This can be gleaned from the correlation matrix. At the 5% significance level, the correlation between variable 2 with variables 4 and 5 is highly significant.

A number of Hypotheses were tested on the difference in responses between male and female respondents. This is summarized in the Table below:

Table 9: Group statistics.

	Gender	N	Mean	Std. Deviation	Std. Error Mean
v2	Male	84	3.10	.913	.100
	Female	77	3.03	1.076	.123
v3	Male	84	1.98	.806	.088
	Female	77	2.09	.814	.093
v4	Male	84	2.81	1.349	.147
	Female	77	2.51	1.354	.154
v5	Male	84	2.70	1.015	.111
	Female	77	2.53	.926	.106
v6	Male	84	1.96	1.080	.118
	Female	77	1.94	1.080	.123

a. H_0: There is no difference between male and female responses with regard to the applications they have running in their production environment.

H_1: There is a difference between male and female responses with regard to the applications they have running in their production environment.

At the 5% significance level, we conclude that there is no difference between male and female responses with regard to the applications they have running in their production environment.

b. H_0: There is no difference between male and female responses with regard to the effectiveness of virtualization in their organization.

H_1: There is a difference between male and female responses with regard to the effectiveness of virtualization in their organization.

At the 5% significance level, we conclude that there is no difference between male and female responses with regard to effectiveness of virtualization in their organization.

c. H_0: There is no difference between male and female responses with regard to the driving force for server virtualization.

H_1: There is a difference between male and female responses with regard to the driving force for server virtualization.

At the 5% significance level, we conclude that there is no difference between male and female responses with regard to the driving force for server virtualization.

d. H_0: There is no difference between male and female responses with regard to the anticipated core business results as a result of deploying server virtualization technology.

H_1: There is a difference between male and female responses with regard to the anticipated core business results as a result of deploying server virtualization technology.

At the 5% significance level, we conclude that there is no difference between male and female responses with regard to the anticipated core business results as a result of deploying server virtualization technology.

e. H_0: There is no difference between male and female responses with regard to the type of virtualization to be deployed in 2012.

H_1: There is a difference between male and female responses with regard to the type of virtualization to be deployed in 2012.

At the 5% significance level, we conclude that there is no difference between male and female responses with regard to the type of virtualization to be deployed in 2012.

An investigation was conducted into what factors contribute significantly towards the applications that a firm has running in their virtualization production environment. In order to accomplish this, the following questions are posed:

a. How strongly they feel about the effectiveness of virtualization
b. Which team drives server virtualization projects

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

c. What are the reasons for virtualization
d. What network issues are a barrier for adopting server virtualization
e. What scalability issues are a barrier for adopting server virtualization
f. What Application performance is a barrier for adopting server virtualization
g. What budgetary issues are a barrier for adopting server virtualization

A Multiple Regression Analysis of the data produced the following results:

Table 10: Coefficients.[a]

Model		Unstandardized Coefficients				
		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.326	.663		6.529	**.000**
	v3	-.060	.099	-.050	-.611	.542
	v4	-.139	.059	-.191	-2.369	**.019**
	v5	-.194	.080	-.194	-2.412	**.017**
	v6					
	v7	.113	.213	.042	.532	.595
	v8	.021	.164	.010	.125	.901
	v9	-.290	.221	-.106	-1.309	.193
	v10	-.021	.179	-.010	-.120	.905

- Dependent Variable: Which Applications does your firm have running in Virtual Production Environment?
- Predictors: (Constant), Can Budgetary issues be a barrier for adopting server virtualization? Is Application performance a barrier for adopting server virtualization? What type of virtualization does your firm currently have or will be deployed in 2012? Are networks issues a barrier for adopting server virtualization? What is your firm's core business results anticipated to achieve at deploying server virtualization technology? (Reasons for virtualization), Which team in your organization is driving server virtualization, network or other virtualization projects? How strongly do you agree to the effectiveness of the virtualization of your organization? Are scalability issues a barrier for adopting server virtualization?

The Multiple Regression Analysis indicates that there are only two variables that impact the choice of applications that a firm has running in their virtual production environment – the team that is driving server virtualization (α=0.019), and the anticipated results anticipated from deploying server virtualization technology in their environment (α=0.017).All the other questions do not significantly impact the applications that a firm has running in their virtual production environment.

An investigation into the perspectives of male and female respondents regarding the major issues associated with adopting server utilization showed that in certain instances, there was a difference in perspective between the genders.

Table 11: Independent samples test.

			.
	F	Sig.	t
v7	12.820	.000	1.729 1.749
v8	.906	.343	.483 .484
v9	1.517	.220	.612 .615
v10	4.299	.040	-1.044 -1.040

f. H_0: There is no difference between male and female responses with regard to network issues as a barrier to server utilization.

H_1: There is a difference between male and female responses with regard to network issues as a barrier to server utilization.

At the 5% significance level, we conclude that there is a difference between male and female responses with regard to network issues as a barrier to server utilization.

g. H_0: There is no difference between male and female responses with regard to scalability issues as a barrier to server utilization.

H_1: There is a difference between male and female responses with regard to scalability issues as a barrier to server utilization.

At the 5% significance level, we conclude that there is no difference between male and female responses with regard to scalability issues as a barrier to server utilization.

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

h. H_0: There is no difference between male and female responses with regard to application performance issues as a barrier to server utilization.

H_1: There is a difference between male and female responses with regard to application performance issues as a barrier to server utilization.

At the 5% significance level, we conclude that there is no difference between male and female responses with regard to application performance issues as a barrier to server utilization.

i. H_0: There is no difference between male and female responses with regard to budgetary issues as a barrier to server utilization.

H_1: There is a difference between male and female responses with regard to budgetary issues as a barrier to server utilization.

At the 5% significance level, we conclude that there is a difference between male and female responses with regard to budgetary issues as a barrier to server utilization.

IMPLICATION FOR MANAGERS AND PRACTITIONERS

Enterprise IT practitioners find that virtualized environments create new general conditions which require new operational processes that create new demands for management solutions. The future requirements on new virtualized infrastructures in enterprise systems should be key indicators as to which components and products are appropriate for implementation
.
Practitioners should conduct a precise analysis of risks relating to various operating processes as part of virtualization project in mid-size and small organizations. Emphasis should be made in relations to the variants, about how many of enterprise virtual machines are to be run on real servers and identify the implications if the servers unexpectedly fail due to unforeseen circumstances.

IMPLICATIONS FOR RESEARCHERS

As this study has shown, virtualization is no-longer an earlier adopter issue because it is now a mainstream breakthrough technology. Majority of enterprise systems are implementing virtualization in live production, as well as in mission-critical applications. The survey result indicated that virtualization is no longer perceived by practitioners and researchers as risky and unreliable but a way on consolidating resources.

The major challenge is for enterprise systems to effectively integrate virtualization management platform with the vendor's hardware-based monitoring systems. This is because information on the status of the hardware helps to prevent system errors. The goal will be for enterprise systems to conglomerate the whole system in one console without redundancies or loss of information while simplifying operation as much as possible.

CHALLENGES

Challenges to this paradigm will come from virtual machine sprawl, network and storage issues as a result to deployment of virtualization and variations in the core support and management of the virtual machine. Also security concerns are paramount. These include the threats targeting virtualized based environments, identifying what needs to be defended such as eliminating blind spots and having total control over virtual machines (VM) sprawl, structuring defenses for consistent protection across physical and virtual environments, aligning the enterprise systems to virtual security operations, keeping pace with hyper-dynamic nature of virtualized environment.

SUMMARY AND CONCLUSION

The study has shown that most enterprise systems mid-size and small businesses computing resources are not utilized effectively. To remain viable and competitive and explore such underutilized resources in 2012-2013, virtualization becomes paramount. Organization will be able to meet and exceed expectation and maintain higher returns on investments. This saves money for the organizations by actualizing flexibility, and improved coordination of resources. Small and mid-size businesses [SMBs] who adopted virtualization can reduce risk of IT outages, critical data loss due to accidents, disaster or emergencies, and lost sales etc. If virtualization is fully implemented and safe guarded, SMBs' will enjoy increases application availability which can dramatically reduce disaster recovery time, thereby improving SMBs' business continuity preparedness.

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  ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy