The Next Generation Network Operations Center

How the Focus on Application Delivery is Redefining the NOC

Ashton, Metzler & Associates

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Dr. Jim Metzler
Ashton, Metzler & Associates

Introduction

The majority of IT organizations are under considerable pressure to evolve to a next generation Network Operations Center (NOC). For example, a survey of 176 IT professionals has uncovered the fact that over a quarter of NOCs do not meet their organization's current needs. In order to fulfill the current and emerging requirements, NOCs are being driven to do a better job of managing application performance, to implement more effective IT processes and to be able to troubleshoot performance problems faster.

While the survey results confirmed the conventional wisdom that a NOC is often stove-piped and reactionary, the results disputed the conventional wisdom that NOC personnel are focused largely on monitoring in general and that they spend the majority of their time on networking in particular. The survey results highlighted the fact that the inability of the NOC to identify issues before the user does hurts the overall credibility of the IT organization and that the role of the NOC is often not well understood – even within the IT organization.

The survey results also showed that while the vast majority of NOCs are undergoing significant change, not all NOCs are starting at the same place in terms of the functionality that they currently provide. In addition, IT organizations do not have a common vision of the structure and functionality of the next generation NOC. To be able to plan for the evolution of their company's NOC in this demanding yet uncertain environment, network professionals need an awareness of what their peers are doing to address the challenges they are facing, as well as an understanding of how well their efforts are succeeding.

One of the goals of this white paper is to provide that awareness. Another goal of this white paper is to identify what IT organizations must do to migrate away from the current stove-piped, reactionary NOC and to an integrated operations center that effectively supports all components of IT.

Methodology

A survey was distributed to a wide range of IT professionals. This resulted in 176 completed surveys. In addition, in depth interviews were conduced with 7 IT professionals to explore trends within distinct industries and job functions. Table 1 contains background information on the interviewees as well as the phrase that will be used to refer to them throughout this white paper.

Title	Industry	Reference Phrase
Network Management Systems Manager	Conglomerate	The Management Systems Manager
CIO	Medical Supplies	The CIO
Network Analyst	Manufacturing	The Manufacturing Analyst
Manager of Network Management and Security	Non-Profit	The Management and Security Manager
Director of Common Services	Education	The Education Director
IT Manager	Manufacturing	The Manufacturing Manager
Global Networking Manager	Energy	The Energy Manager

Table 1: The Interviewees

When analyzing survey results it is sometimes important to make judgments about the applicability of the respondents' answers by considering their job functions. With that in mind, this white paper highlights the differences between two groups of survey respondents. One group either works in the NOC or has management responsibility for the NOC. These respondents will be referred to in this white paper as NOC respondents. The second group is everyone else, and will be referred to in this white paper as non-NOC respondents. It is important to realize that the vast majority of the non-NOC respondents work in the IT organization. Throughout this white paper when the survey results are being discussed, if no mention is made of the respondents' job functions, the data given are for the entire universe of survey respondents.

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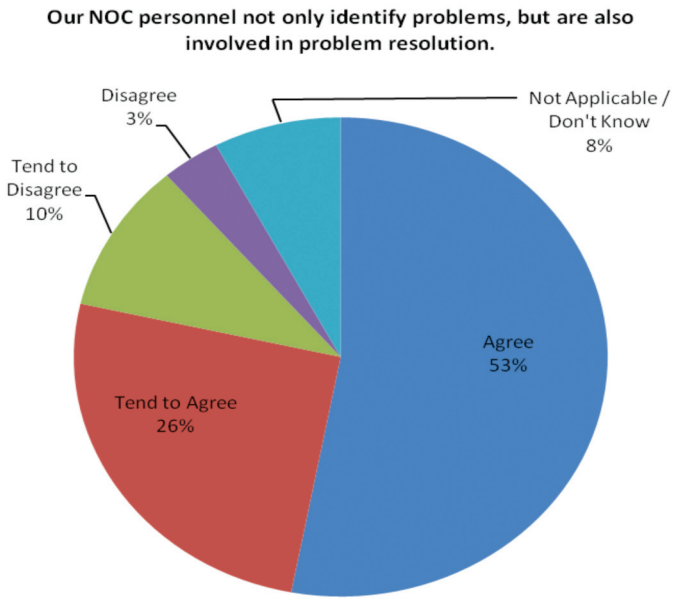

Figure 1: Role of the NOC in Problem Resolution

Responding to a Trouble

The vast majority of organizations have at least a simple escalation process in place for problem response. In particular, 91% of Survey Respondents indicated that their organization has a help desk that assists end users, and 80% agree that the help desk does a good job of routing issues that it cannot resolve to whichever group can best handle them. It should be noted that of the latter group of respondents (those agreeing), 81% stated that the help desk typically routes issues that it cannot resolve to the NOC. This is not surprising for two reasons. One reason is that three quarters of the survey respondents also indicated that the network is generally assumed to be the source of application response time degradation. Sending a trouble ticket to the NOC is reasonable if the assumption is that the network is the source of the problem. Another reason why this is not surprising is that, as will be shown later in this white paper, in many instances the NOC supports a far broader set of functionality than just networks.

There are also cultural reasons why the help desk typically routes issues that it cannot resolve to the NOC. For example, The Manufacturing Analyst stated that in his company, if there is an IT problem the tendency of the user is to contact the NOC because "We have always had the tools to identify the cause of the problems."

> "…the NOC supports a far broader set of functionality than just networks."

The Manufacturing and Security Manager stated that as recently as a year ago his organization had a very defensive approach to operations with a focus on showing that the network was not the source of a trouble. His current motto is "I don't care what the problem is, we are all going to get involved in fixing it." When asked if his motto was widely accepted within the organization he replied, "Some of the mentality is changing, but this is still not the norm."

The Survey Respondents were asked to indicate their degree of agreement with the statement: "Our NOC personnel not only identifies problems, but are also involved in problem resolution." Their responses are depicted in Figure 1.

One of the clear results of the survey is that the NOC is typically involved in more than monitoring activities. Figure 1 indicates how the vast majority of NOCs also get involved in problem resolution. Later in this white paper, the other activities that the NOC gets involved in will be identified.

What About ITIL (IT Infrastructure Library)?

There has been significant discussion over the last few years about using a framework such as ITIL to improve network management practices. To probe the use of ITIL, the survey respondents were asked if their organization has an IT service management process like ITIL in place or intends to adopt such a process within the next 12 months. The majority of respondents (62%) indicated that their organizations do have such a process in place. Of those respondents who do not, a similar percentage (63%) believe that their organization will put such a process in place within the next 12 months. The fact that 86% of respondents stated that their organization either have or will have within 12 months a service management process in place indicates the emphasis being placed within the NOC to improve its processes.

While the survey data highlighted the strong interest in ITIL, the interviewees were not as enthusiastic. For example, The CIO said that his organization tried to use ITIL to improve some of its processes. However, while he does not disagree with the benefits promised by ITIL, he finds it to be too theoretical and he lacks the resources to get deeply involved with it.

The Manufacturing Analyst stated that his organization has begun to use ITIL but they "do not live by the [ITIL] book." He believes ITIL will make a difference, but probably not that big of a difference.

The Management Systems Manager stated that her company has done a lot of ITIL training and that there is some interest in setting up a CMDB (Configuration Management Data Base). However, their ability to improve processes is limited by the organizational structure. For example, the central IT group has set up a change management process that calls for a weekly meeting to review changes that cut across organizational silos. However, some sites control their own LANs and if one of these sites makes a change to its LAN, it does not go through the change management process set up by the central IT group.

How is the NOC Perceived?

This white paper's introduction alluded to political drivers affecting the evolution of the NOC. One of the most important of these is the perception of the NOC's current function and value. The perception from inside and outside the NOC can be very different. This can have a big impact on NOC staffing and funding – both of which heavily influence the NOC's ability to implement change.

Three quarters of the survey respondents believe that NOC personnel are aware of the key infrastructure components that support the company's critical applications. Since such awareness is the basis aligning IT operations with key business drivers, this indicates that most respondents view the NOC as being positioned to align itself with the business.

It was disappointing to see that only a small majority of Survey Respondents (58%) believe that the role of the NOC is understood by the entire IT organization. It was heartening, but somewhat surprising, to see that slightly more (63%) of the respondents believe that business managers do understand the role of the NOC. This is an instance in which there was not any significant difference in the responses based on job function.

The CIO said that some business managers "get" the role of the NOC. However, he added that a lot of business leaders see IT as one big blob and this lack of understanding of IT can cause problems. He said, "When times are good, the business managers forgive how much we spend on IT. However, when business is going through a down cycle they ask, 'Why are we paying so much for IT?'"

To further probe perceptions of the value of the NOC, we asked the Survey Respondents if they thought that working in the NOC is considered to be prestigious. The NOC respondents were evenly split on this issue. That was not the case with non-NOC respondents. By roughly a 2 to 1 margin, these respondents indicated that they do not think that working in the NOC is prestigious.

The Survey Respondents were also asked a series of questions regarding senior IT management's attitude towards the NOC. The results are shown in Table 2.

> "…only a small majority of Survey Respondents (58%) believe that the role of the NOC is understood by the entire IT organization."

Disagree/	Tend To Agree	Tend to Disagree
the NOC provides value to our organization.	90.7%	9.3%
the NOC is a strategic function of IT.	87.9%	12.1%
the NOC is capable of resolving problems in an effective manner.	82.4%	17.6%
the NOC will be able to meet the organization's requirements 12 months from now.	81.4%	18.6%
the NOC works efficiently.	80.6%	19.4%
the NOC meets the organization's current needs.	71.9%	28.1%

Table 2: IT Management's Perception of the NOC

Overall the data in Table 2 is positive. However, there is a notable exception. Over a quarter of the total base of Survey Respondents indicated that the NOC does not meet the organization's current needs.

The Manufacturing Manager described his concerns about the ability of the network support organization to meet the organization's current needs. He said the personnel in his organization's NOC are "not very network savvy." The personnel in the NOC are primarily concerned with network availability and once they are alerted to a possible trouble they follow a simple script to try to resolve it. To illustrate their role, the Manufacturing Manager said that if a router goes down, a script instructs the NOC personnel to take a few steps to fix the problem, but if those steps do not work, they call a level 2 support analyst. He said that his organization is not satisfied with the role and performance of the NOC and has considered outsourcing the function. They have, however, decided to keep the function in-house but are committed to improving its ability to respond to problems.

What Does the NOC Do?

As will be shown in the next few sections of this white paper, the functions that a NOC currently performs vary widely among IT organizations. For example, The Management Systems Manager pointed out that the NOC in which she works supports the company's WAN and some LANs. It does not support LANs in those sites where local staff believe that they can support the LAN more cost effectively themselves.

The Energy Manager explained that his company's network supports almost 700 locations from a single NOC. He added that their facilities are scattered around the globe and that many of their facilities are in parts of the world that do not have a robust network infrastructure. He went on to explain that as a result of the infrastructure conditions where their facilities are located, NOC personnel spend roughly 90% of their time working to resolve local loop issues.

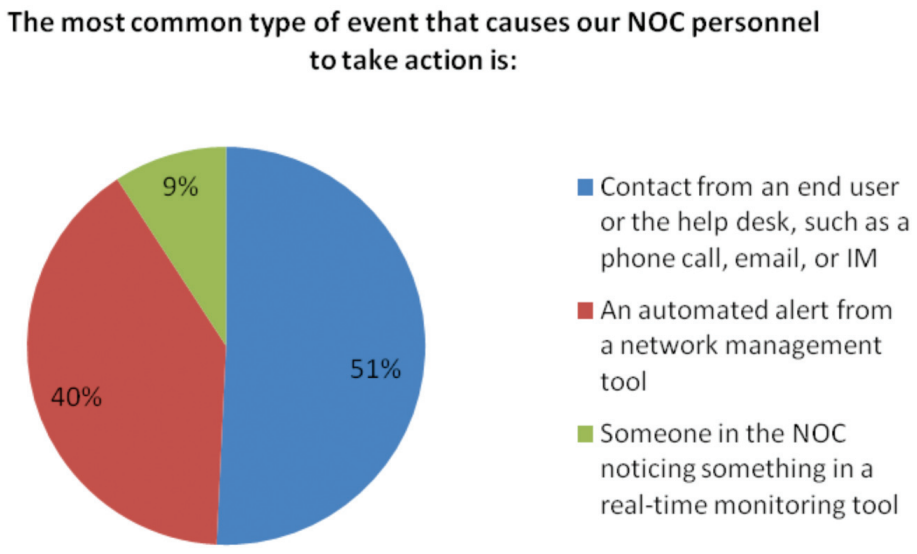

Figure 2: Events that Cause the NOC to Take Action

When it comes to how the NOC functions, one of the most disappointing findings is that just under two thirds of the NOC respondents believe that the NOC tends to work on a reactive basis, identifying a problem only after it impacts end users. The survey also asked the respondents about the most common type of event that causes NOC personnel to take action. The replies of the NOC respondents who provided a response other than "don't know" are depicted in Figure 2. The data in Figure 2 indicates that roughly half the time either someone in the NOC or an automated alert causes the NOC to take action. This data, however, does not address the issue of whether or not this occurs before the user is impacted.

The CIO stated that the most frequent question he gets from users is, "Why don't you know that my system is down? Why do I have to tell you?" He said that the fact that end users tend to notice a problem before IT does has the affect of eroding the users' confidence in IT in general.

> "…just under two thirds of the NOC respondents believe that the NOC tends to work on a reactive basis, identifying a problem only after it impacts end users."

The Management and Security Manager stated that his organization has implemented tools to automate most Level 1 issues and that they still have a help desk that takes calls from users and attempts to solve the problem. He added that, "All of us at one time came from a help desk so we have an obligation to make them successful." The personnel at his company's help desk can view reports from some of the management tools so that when talking to a user about a problem they can be more knowledgeable and helpful.

The conventional wisdom in our industry is that NOC efficiency is reduced because of the silos that exist within the NOC. In this context, silos means that the workgroups have few common goals, processes and tools. Just under half of the survey respondents indicated that their NOC has functional silos. In addition, a small majority (61%) of NOC personnel feel that they use many management tools that are not well integrated.

The Management Systems Manager stated that it is challenging to bring together the IT groups necessary to resolve a problem. She added that the group responsible for the performance of applications and servers has very little understanding of the network. The Manufacturing Analyst said that having management tools that are not well integrated "is a fact of life." He added that his organization has a variety of point products and does not currently have a unified framework for these tools. This is one of the issues his company is hoping to change with a NOC redesign project currently underway.

Where Does the NOC Spend Most of Its Time?

To identify the areas in which NOC personnel spend most of their time, the survey contained three questions:

During the past 12 months, our NOC personnel have…

1 spent the greatest amount of time addressing issues with…

2 spent the second greatest amount of time addressing issues with…

3 seen the greatest increase in time spent addressing issues with…

where each question contained a number of possible answers. Table 3 shows the answers of the NOC respondents.

	Greatest Amount of Time	Second Greatest Amount of Time	Greatest Increase in Time
Applications	39.1%	16.9%	45.0%
Servers	14.1%	21.5%	21.7%
LAN	10.9%	15.4%	5.0%
WAN	23.4%	30.8%	11.7%
Security	9.4%	6.2%	10.0%
Storage	3.1%	9.2%	6.7%

Table 3: Where the NOC Spends the Most Time

There are many conclusions that can be drawn from the data in Table 3. One conclusion is that NOC personnel spend the greatest amount of time on applications, and that that is a relatively new phenomenon. An additional conclusion is that NOC personnel support a broad range of IT functionality.

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The CIO said that the percentage of time his organization spends monitoring and troubleshooting network problems varies from month to month, but it is probably in the range of ten to twenty percent. The Manufacturing Analyst said that his organization focuses on the availability of networks and does not get involved in problem resolution. He added, however, that there is a project underway to change how the NOC functions. The goal of the project is to create a NOC that is more proactive and which focuses both on performance and availability.

The Education Director stated that his group has responsibility for network operations, some services such as conferencing, as well as some key applications. He added that in general, "The network people understand networks and the application people understand applications." One exception to that statement, he said is Oracle. Because of the importance of Oracle, the networking people have become quite familiar with how it functions.

When analyzing where the NOC spends its time, however, equally interesting is the vast gap in perceptions between those inside and outside the NOC. Table 4 indicates where NOC personnel spend the greatest amount of time and contrasts that to where non-NOC personnel believe NOC personnel spend the greatest amount of time. As is clearly indicated, NOC personnel say they spend the most time on applications. However, non-NOC personnel not only do not perceive this, but roughly half of them believe that NOC personnel spend the greatest amount of their time on the WAN. This perception gap is supported by the earlier data that indicates the role of the NOC is not well understood outside of the NOC.

	Greatest Amount of Time	
	NOC	Non-NOC
Applications	39.1%	17.2%
Servers	14.1%	22.4%
LAN	10.9%	3.4%
WAN	23.4%	48.3%
Security	9.4%	5.2%
Storage	3.1%	3.4%

Table 4: Contrasting Views of the NOC

As previously noted, the role of the NOC has recently changed to a point where NOC personnel spend the greatest amount of their time on applications. To put that into perspective, roughly three-quarters of the respondents indicated that NOC personnel now perform some functions that were previously considered to be Level 2 or Level 3 functions. Another important area of change within the NOC is the shift away from having NOC personnel monitoring management consoles all day waiting for green lights to turn yellow or red. In particular, over a quarter of the NOC respondents indicated that their company had "eliminated or reduced the size of our NOC because we have automated monitoring, problem detection and notification." It is important to note that in all likelihood a notably higher percentage of organizations have implemented automated monitoring but have not eliminated or reduced the size of their NOCs. This view of the growing importance of automation is supported by the data in Figure 2.

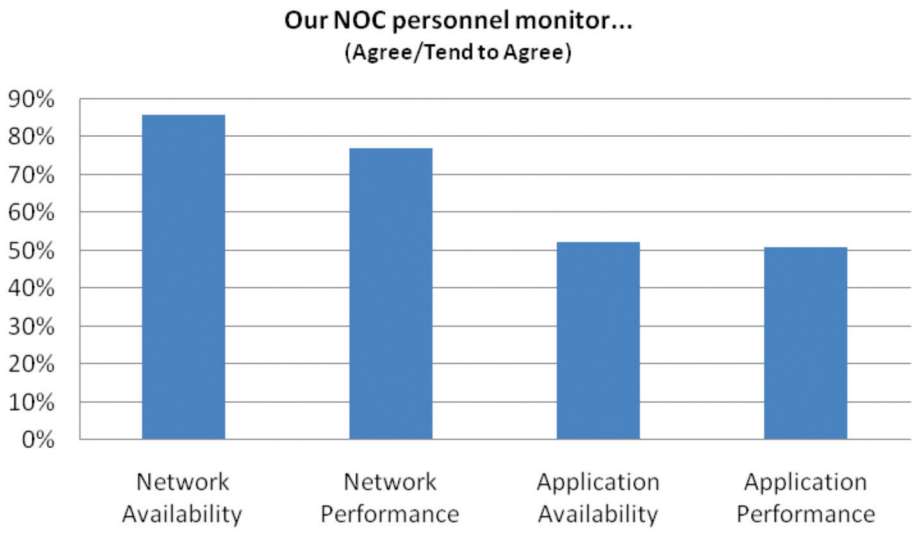

Figure 3: What the NOC Monitors

While the general trend is for the NOC to be more involved in supporting applications, not all organizations are heading in that direction. The Management Systems Manager pointed out that her organization does not focus on applications. In her company there is a separate performance and availability group that focuses on the performance of applications and servers.

What Do NOC Personnel Monitor?

The Survey Respondents were asked four questions about what their NOC personnel monitor.
The results from NOC respondents are shown in Figure 3.

The data in Figure 3 clearly shows that the NOC is almost as likely to monitor performance, as it is to monitor availability. In addition, while there is still more focus in the NOC on networks, there is a significant emphasis on applications. This is further validation of the data contained in Table 3.

Interestingly, there was very little difference in response between NOC and non-NOC personnel. Taking into account the data in Table 4, it appears that non-NOC personnel do understand that the NOC is monitoring application availability and performance, but that they seriously underestimate the time this takes.

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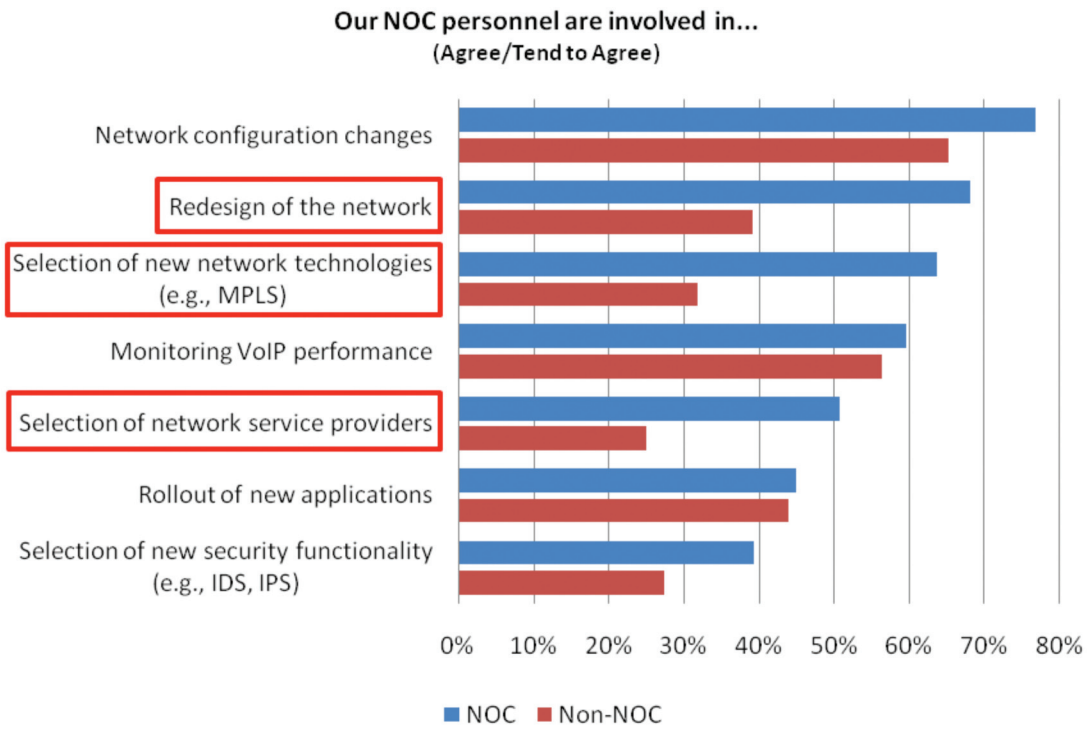

Figure 4: NOC Personnel Tasks

What Else Does the NOC Do?

We also asked the Survey Respondents about other tasks or responsibilities that NOC personnel are involved in. Figure 4 shows the responses for both NOC and non-NOC personnel.

The most obvious conclusion that can be drawn from Figure 4 is that NOC personnel are involved in myriad tasks beyond simple monitoring. As shown, NOC personnel are typically involved in traditional network activities such as configuration changes, selection of new network technologies and the selection of network service providers. The NOC is less likely to be involved in application rollouts, but are involved to a degree that is somewhat consistent with their ongoing responsibility for application availability and performance (Figure 3).

The responsibilities outlined in red are where NOC and non-NOC respondents differed most in their responses. Interestingly, the areas where there were the greatest differences are all traditional networking activities.

The CIO stated that he gets his operations function involved in other tasks, such as the selection of an MPLS service provider. He said, "Too often the best groups are left out and companies wait for the CIO to descend from the mountain and tell everyone the direction."

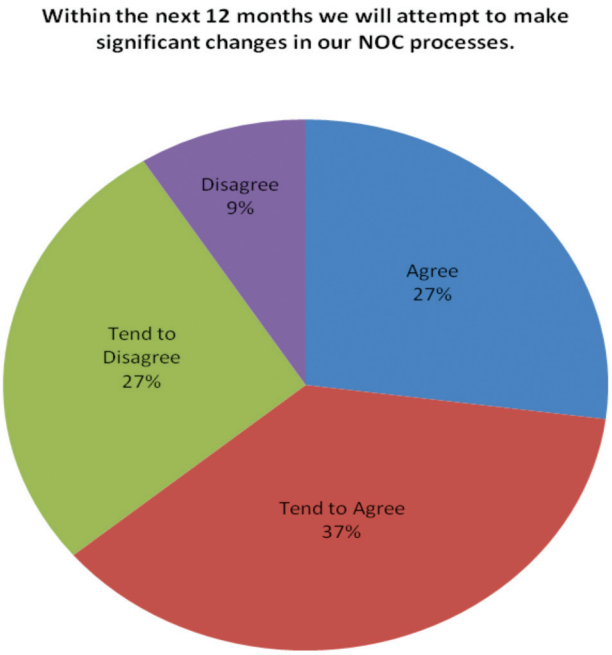

Figure 5: Interest in Changing NOC Processes

Factors Driving or Inhibiting Change

As shown in Table 2, over a quarter of the total base of survey respondents indicated that the NOC does not meet the organization's current needs. This level of dissatisfaction with the NOC is supported by the data in Figure 5 which shows almost two thirds of the respondents believe their organizations will attempt to make significant changes in their NOC processes within the next 12 months.

> "Too often the best groups are left out and companies wait for the CIO to descend from the mountain and tell everyone the direction."

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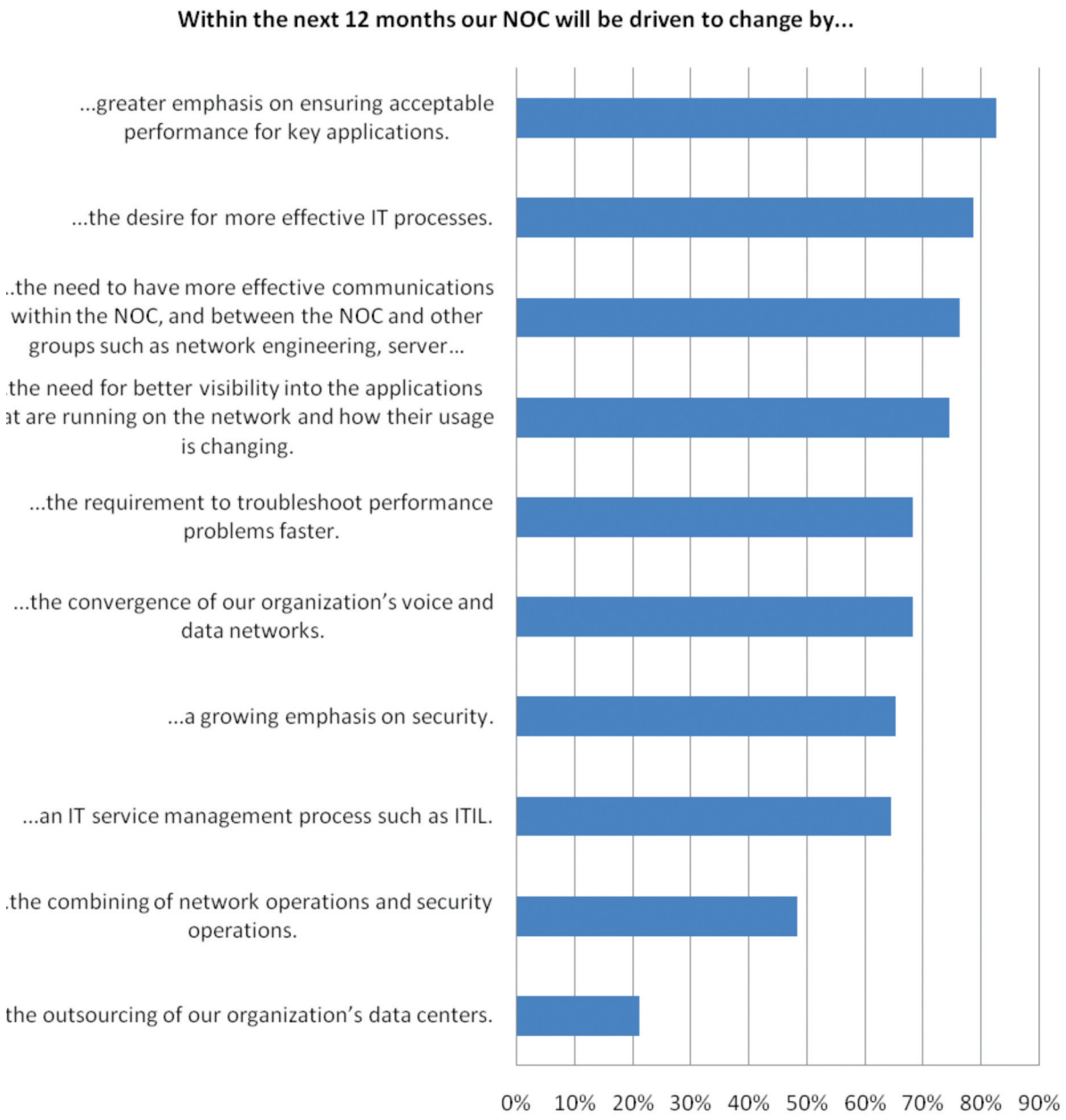

Figure 6: Factors Driving Change in the NOC

Factors Driving Change

The Survey Respondents were asked to indicate which factors will drive their NOC to change within the next 12 months. Their responses are shown in Figure 6.

One clear conclusion that can be drawn from the data in Figure 6 is that a wide range of factors are driving change in the NOC. Given that NOC personnel spend the greatest amount of time on applications, it is not surprising that the top driver of change is "greater emphasis on ensuring acceptable performance for key applications." A related driver, "the need for better visibility into applications," is almost as strong a factor driving change.

The Energy Manager stated that currently the NOC does not play a role in resolving application degradation issues. Within his company application degradation issues are handled by network engineers. However, he pointed out that this approach has some limitations. In particular, application degradation issues can occur anytime and typically need to be addressed immediately. As a result, these issues are assigned to engineers around the world based on the time of day and who is working at that hour. Assigning application degradation issues to these engineers inhibits their ability to perform other job responsibilities. In addition, if the problem is not resolved before they leave work for the day, they either must brief another engineer in a different part of the world on the issue and what has been done, or put off working on the problem until the next day. The Energy Manager went on to say that they are currently in the process of providing training to selected NOC personnel to help them resolve application degradation issues. He commented that he has some concerns about how successful the current NOC personnel will be at resolving application degradation issues due to the specialized nature of the task.

The desire for more effective processes, the need to have more effective communications, and the deployment of an IT service management process are also key drivers of change in the NOC. This is consistent with the data in Figure 5 showing interest the Survey Respondents have in ITIL.

As shown in Table 3, NOC personnel do not spend a lot of their time today on security. However, this may change in the next year as roughly half of the Survey Respondents indicated that combining network and security operations would impact their NOC over the next 12 months. In addition, two thirds of the Survey Respondents indicated that a growing emphasis on security will impact their NOCs over the next 12 months.

The CIO stated that in order to place greater emphasis on ensuring acceptable performance for key applications, they have formed an application delivery organization. He added that roughly a year ago they first began to use some monitoring tools and that these tools "Opened our eyes to a lot of things that can degrade performance and not cause any of the traditional green lights to turn yellow or red." He stated that going forward, he wants to place more emphasis on security although he said he thought it would be difficult to combine security and network operations into a single group. His rationale for that statement was that security operations involves so much more than just networks.

> "…the top driver of change is *greater emphasis on ensuring acceptable performance for key applications,…*"

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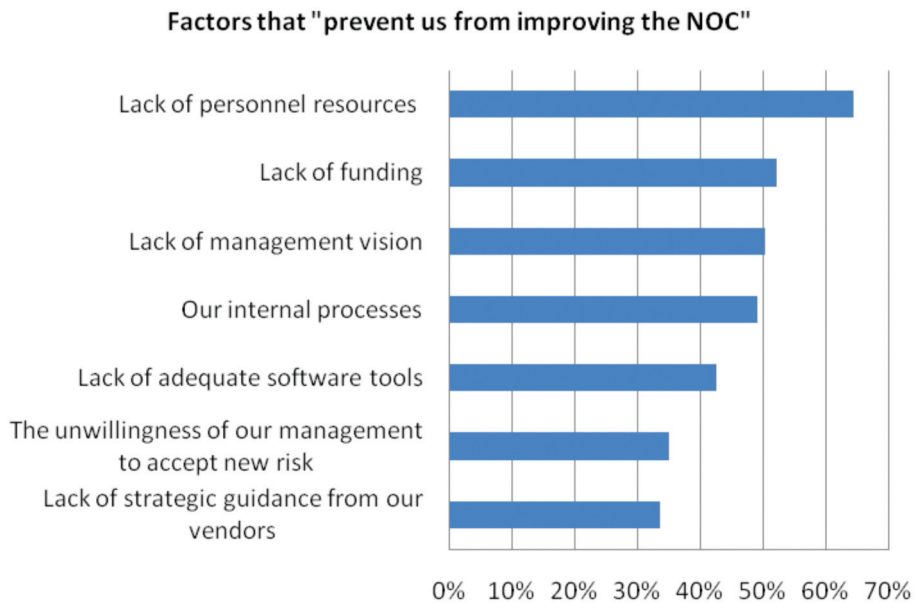

Figure 7: Factors Inhibiting Change in the NOC

The Management and Security Manager stated that one of his company's goals is to better understand the impact of problems and who is impacted. One of the reasons for this goal is to be able to better communicate with the impacted users, potentially in an automated fashion. Some of his other goals are more focused on organization than on technology. He stated that they are trying to "Get out of the mentality of what is the network group and what is the server group. We have to become more integrated." He also stated that roughly a year ago the IT organization established relationship managers to interface with the business managers. They now need to implement processes to sift through and prioritize the feedback coming from the business managers.

Factors Inhibiting Change

Particularly within large organizations, change is difficult. To better understand the resistance to change, we asked the Survey Respondents to indicate what factors will inhibit their organizations from improving the NOC. Their responses are shown in Figure 7.

It was not surprising that the two biggest factors inhibiting change are the lack of personnel resources and the lack of funding. This is in line with the general trend whereby IT budgets are increasing on average by only single digit amounts and head count is often held flat. It is also not surprising that internal processes are listed as a major factor inhibiting change. The siloed NOC, the interest in ITIL and the need to make significant changes to NOC processes have been constant themes throughout this white paper.

The Management Systems Manager stated that her organization monitors network availability but does not monitor network performance. She added that her organization would like to monitor performance but "It is a resource issue. The only way we can monitor performance is if we get more people." On a related issue, The Management Systems Manager said that due to relatively constant turnover in personnel, "Management vision changes every couple of years. Some managers have been open to monitoring performance while others have not believed in the importance of managing network performance."

Even if her NOC does not begin to monitor performance, The Management Systems Manager doubts that the NOC will be able to meet the growing demand for its services a year from now. She said, "Hopefully the NOC will be allowed to scale. However, typically growth in demand happens first and the growth of the NOC happens a lot later."

Call to Action: The Next-Generation Integrated Operations Center

The market research that was presented in this white paper demonstrates that there is considerable dissatisfaction with the role currently played by the NOC and as a result there is also widespread interest in making significant changes to the NOC. Given the interest in making significant changes to the NOC, this section will describe the key characteristics of a truly next generation NOC – one that integrates the operations of each component of IT.

An Integrated Operations Center (IOC) would not have to be housed in a single facility, nor would it necessarily have to be provided by a single organization within the IT function. However, independent of how it is organized, the IT professionals who work in an IOC must have a common language[1] and common goals. Below is a listing of the other key characteristics of an IOC as well as a summary of where the bulk of IT organizations currently stand relative to each characteristic.

Efficient Processes

There is clear recognition on the part of the survey base that the NOC needs to improve its processes. There is also clear acknowledgement that the vast majority of IT organizations will use ITIL as part of their process improvement efforts. However, The Manufacturing Analyst summarized the feeling of many IT professionals when he said, "ITIL will make a difference, but probably not that big of a difference."

Focus on Performance

Today's NOC is almost as likely to focus on performance as it is to focus on availability. This focus on performance will likely increase in the near term in part because placing greater emphasis on ensuring acceptable application performance for key applications is the strongest factor driving change in the NOC. However, as strong as the movement is to focus on performance, it is not universal. For example, The Management Systems Manager pointed out that due to relatively constant turnover in personnel, "Management vision changes every couple of years. Some managers have been open to monitoring performance while others have not believed in the importance of managing network performance."

Skilled Staff

In general, the skill set of NOC personnel has been increasing and the majority of NOC personnel are now performing functions that until recently were considered to be Level 2 or Level 3 functions. However, while the skill of NOC personnel has generally been increasing, there is still room for improvement. For example, both The Manufacturing Manager and The Energy Manager discussed the limited skill set of their NOC personnel as well as the attempts that their organizations are undertaking to increase these skill sets.

Automation and Intelligent Tools

Many NOCs have begun the shift away from having NOC personnel sitting at screens all day waiting for green lights to turn yellow or red. For example, The Management and Security Manager stated that his organization has implemented tools to automate most Level 1 issues. In addition, over a quarter of the NOC respondents indicated that their company has "eliminated or reduced the size of our NOC because we have automated monitoring, problem detection and notification." This trend, combined with the trend to increase the skill set of NOC personnel, indicates that more intelligence is being placed in the NOC, and that intelligence is a combination of people and tools.

Integrated Set of Tools

As was pointed out by The Manufacturing Analyst, having management tools that are not well integrated "is a fact of life." This situation, however, may be changing as The Manufacturing Analyst also expressed a common theme of the market research when he added that tool integration is one of the biggest issues his organization hopes to address with the NOC redesign project they currently have underway.

Focus on Applications

NOCs currently have a significant focus on managing application performance. There is also very strong interest in having NOCs get better at managing application performance. As a result, it is highly likely that within the next two years the vast majority of operations centers will be managing application performance.

Focus on Security

NOC personnel do not currently spend a lot of their time on security. However, two thirds of the survey respondents indicated that a growing emphasis on security will impact their NOC over the next 12 months. In addition, almost half of the Survey Respondents indicated that combining network and security operations will impact their NOC over the next 12 months.

[1] An example of having a common language is that everyone in the IOC has the same definition for the word service.

Being Proactive

In spite of the widespread interest in being proactive, the majority of the NOCs currently work on a reactive basis, identifying a problem only after it impacts end users. There is some evidence that this may be changing. For example, The Manufacturing Analyst expressed the feeling of many of the interviewees when he said that his organization has a project underway and that one of the goals of the project is to create a NOC that is more proactive.

The migration away from today's stove-piped, reactionary NOC to an effective IOC that exhibits the characteristics described above will not be easy. This migration will require the active involvement of both the senior management as well as rank and file members of the operations function. Part of senior management's role is to articulate a clear vision of the future role of the operations center, and to be the champion of that role, both inside of the IT organization as well as more broadly within the company. In addition, senior management must ensure the creation of a road map that leads to an effective IOC and must also closely manage the journey.

While it is the role of senior management to create the vision and the road map, a major part of the role of the rank and file members of the operations function is to ground senior management in terms of what is possible in what time frame. The rank and file must also work with senior management to establish a program comprised of formal training, on-the-job training, and job rotations that leads to increasing and broadening the skills of the operations group. In addition, the rank and file must embrace change as their jobs five years from now will have very little in common with what their jobs were five years ago.

Dr. Jim Metzler
Ashton, Metzler
& Associates

Dr. Jim Metzler is widely recognized as an authority on both network technology and its business applications. In over 28 years of professional experience, Jim has assisted numerous vendors in refining their product and service strategies, and has helped enterprises update their network infrastructures. Jim has served the IT industry in many roles that include developing a compiler for a branch of the U.S. intelligence community, creating software tools used to design customer networks for a major inter exchange carrier, managing high speed-data services for a major telco, being a product manager for a network hardware vendor, managing networks at two Fortune 500 companies, directing and executing market research at a major industry analyst firm, and running a consulting organization. Jim has co-authored a book published by Prentice Hall titled "Layer 3 Switching: A Guide for IT Professionals," and he is a popular speaker at industry events. Jim holds a Ph.D. in Numerical Analysis from Boston University.

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NetQoS®
Performance Experts

NetQoS Global Headquarters

5001 Plaza On The Lake
Austin, TX, 78746
United States
Phone: 512.407.9443
Toll-Free: 877.835.9575
Fax: 512.407.8629

NetQoS EMEA

1650 Arlington Business Park
Theale Reading, RG7 4SA
United Kingdom
Phone: + 44 (0) 118 929 8032
Fax: + 44 (0) 118 929 8033

NetQoS APAC

NetQoS Singapore
Representative Office
Level 21, Centennial Tower
3 Temasek Ave.,
Singapore 039190
Phone: + 65 6549 7476
Fax: + 65 6549 7001

Website: www.netqos.com
E-mail: sales@netqos.com

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