Operational Efficiency in FTTH Networks

A White Paper by the
Deployment & Operations Committee

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1 Introduction

Fibre to the home (FTTH) is widely accepted as the most powerful form of fixed access network, which will be able to meet bandwidth demand not just in the immediate future but over the longer term.

The business case for FTTH is heavily dependent on the upfront cost of building the network. As a result, much attention has been focused to the need for efficiency in strategic network planning and technical deployment methods with the aim of reducing the initial capital expenditure (capex) requirement. Indeed, last year this committee published a white paper about *Innovative FTTH Deployment Technologies*. However, network operation and maintenance should not be overlooked. The build phase is only the beginning; once the network is operational, the main challenge will be to keep it that way.

This white paper addresses the subject of how to optimise FTTH operations and maintenance (OAM) processes. The aim is to minimise operational costs (opex) by reducing the complexity of OAM processes and decreasing the amount of staff time that must be spent on them, so that the network operates reliably, but is able to recover quickly from any outages, and changes can be managed easily. The impact of OAM processes on the cost of upgrading the network in the future will also be considered.

The enhanced Telecom Operations Map (eTOM), published by the TM Forum, provides a framework for all business processes that are relevant to telecommunications and IT companies. It provides a comprehensive, multi-layered view of the key processes that are required to run an efficient and effective enterprise.

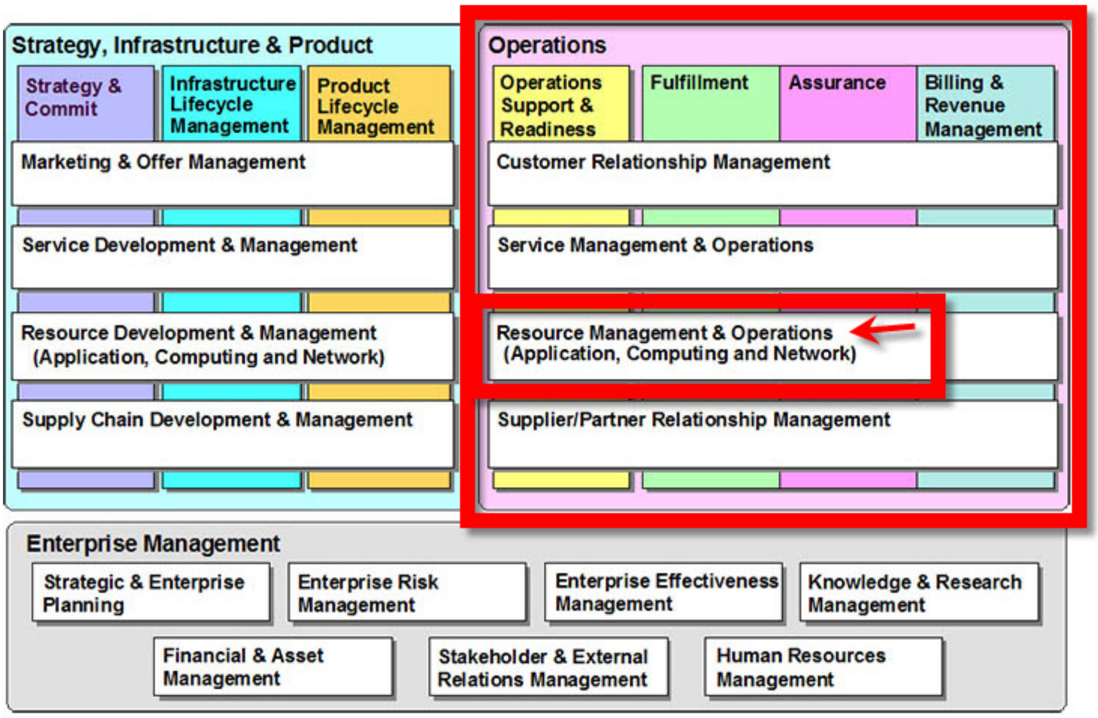

Figure 1: eTOM model. Source: TM Forum

The highlighted blocks in Figure 1 show which parts of the eTOM map are addressed in this white paper. The main focus is on the process-related technical aspects covered by “Resource Management & Operations”. Repair and maintenance falls under the heading “Assurance”. The issues raised by this paper are related to but independent of the framework, so the discussion should also be relevant to operators who have decided not to adopt eTOM.

Under these headings, it is possible to identify several topics that are of particular relevance to FTTH operators. Based on their experience in the real world, network operators have provided more detail on the questions that have an impact on operational efficiency, such as:

- How should the network be designed so that it is easier to manage changes and upgrades?
- How can faults be identified and located quickly? (Hint: good network documentation is key.)
- How can operations and maintenance procedures and logistics be improved?

The first of these questions addresses the importance of forward thinking and the impact of the strategic decisions made at the outset of the project. The second area focuses on the need to create and maintain high-quality network documentation. The final part is about how to use process management to standardise and streamline operations and logistics processes and thus improve service performance. The aim is not simply to find a solution to a one-off technical problem, but to manage the normal, day-to-day maintenance tasks so that they can be carried out efficiently.

2 Make the Right Strategic Decisions

Even before the network has been built, decisions are made that will determine important aspects of its future operations and maintenance. Therefore, the best basis for the efficient operation and maintenance is a well-considered and consistent network strategy from the outset. The strategy should cover all aspects of how the network will be built and extended, including the network topology and architecture, the design rules and the choice of equipment.

During the strategic planning phase, the network operator decides how the network will be built. There is much more to consider than just the initial investment. Although it is important to reduce the capex because of its impact on the viability of the business case, the opex should also be carefully considered. For every deployment option the operator should evaluate how this would affect the cost of future operation and maintenance processes, such as customer provisioning, network maintenance and repair, and how easily the network could be extended and upgraded.

Please note that this paper focuses on the technical aspects of the deployment strategy only. The dependencies of the ownership and financial models, which also influence strategic decisions, are beyond the scope of the paper and will not be taken into account.

The following three aspects will be investigated:

- network deployment strategy
- future migration strategy
- supplier strategy

2.1 Network Deployment Strategy

It is important that the network operator chooses the optimum network architecture, technology, and equipment to suit the circumstances and the proposed network deployment strategy. The network topology – whether point-to-point (P2P) or point-to-multipoint (P2MP) – has less of an influence on the operational efficiency of the network, but it will become important for the future migration strategy, described later.

In our paper we consider the following three network deployment strategies:

- full network rollout (covering all households)
- partial network rollout (using third-party infrastructure)
- network extension based on customer request

For the first two scenarios we can distinguish between "homes passed" (prepared for connection) and "homes connected" (homes with active subscribers).

In the first strategy, "full network rollout", the communications provider deploys the network inside the complete service area within a defined timeframe. The deployment plan is independent of the number of customers who will use the new infrastructure. The advantage of this approach is that it is possible to optimise the roll-out process right at the start. The optimisation can cover:

- location of fibre concentration points (FCPs)
- capacities of cables and conduits
- P2P versus P2MP topology
- degree of splitting and splitter placement in case of P2MP topologies
- spare fibre capacities
- placement of equipment in racks
- fibre assignment at the splice cassettes and within cables

With this approach, there is no need to add fibre connections at some future time because the network path between customer and central office is completely installed from the outset. Robust underground closures can be used at the fibre concentration points to reduce the risk of failure, because for the full network rollout the work at these concentration points is mainly done once during the initial deployment.

The problem with this approach is that the development of urban streets and buildings can happen so quickly that it is not possible to plan the exact route of the optical cables in advance. Often the real network requires capex that is 30% higher compared to the cost-optimised structure.

To reduce upfront costs, the full rollout can be changed to a less strict variant, where drop cables are not yet spliced at the fibre concentration points. This can save on the initial cost of installing feeder cables, but new feeder cables have to be added later when they are required.

The way cables are laid in the ducts only becomes relevant from an operational point of view when there is network failure. In the event of a cable cut, fittings and closures are required to repair the network, or in the worst case the complete cable has to be replaced. If the cable has to be replaced, it will cost more and take longer to repair the cable if no duct or conduit has been used. If protective ducts are used it may be possible to add a new cable to replace the damaged cable without having to dig up the street. There is a trade-off, however, because the effort to repair duct systems is higher, and a cable cut can sometimes affect both end points of the cable. In the worst case scenario the cable would need to be repaired at three locations. Deploying micro-duct systems is the most flexible approach, but at the same time the effort to repair is high.

In the scenario “homes passed” it is possible to reduce the effort required for installation, for example, by using pre-assembled cables. The cable end points remain underground in front of the buildings, but they are already spliced at the fibre concentration points. That means the later effort to connect a customer is reduced to the final installation at the central office and at the customer location.

In the case of a partial network rollout, whether the operator uses third-party infrastructure or extends the network based on customer request, the network will expand step by step and its design will be constantly changing. Efficiency can only be achieved if the network structure is designed to be flexible and the required number of work processes in the network rollout is minimised. That means overhead lines or duct/micro-duct based structures should be considered for cable deployment. Micro-duct systems allow cables to be added at a later date.

From an installation and maintenance point of view, the number of fibre concentration points should be reduced in order to reduce the number of potential points of failure and to reduce the effort of installation. Instead of underground closures, in this case cabinets are the best choice for the fibre concentration points, because access will be required for continuous changes. Connectors are recommended in all fibre concentration points because they allow easier additions and changes.

In the scenario where the network is extended based on customer request, the network will be rolled out in certain geographical areas, e.g. parts of towns or cities, small towns, or villages, according to the results from market analysis or customer surveys. For example, in Germany a take rate of more than 70% within a certain area is generally seen as sufficient for a positive business case. The second possibility is a customer request from an enterprise. Due to the higher service fees for business customers, it can be worthwhile to connect single enterprises with fibre, especially if they are located within industrial areas. This usually results in a mesh network along the streets within these industrial zones.

2.2 General Network Design Rules

The following design rules of the strategic planning process will be discussed in more detail, because they have a major impact on the operational costs of the network, once built. These two aspects are relevant to all three network rollout strategies:

- spare capacity
- flexibility and accessibility

Please note that when we talk about efficiency of operations, operational costs are not the only consideration, but also time (outage time, time to repair), and the availability of people and skills.

2.2.1 Spare capacity

The value of investing in sufficient spare capacity should be obvious. While operating the network in a competitive market, the customer base will change and different homes will need to be activated and de-activated over time. The effort required for this recurring task has a significant impact on the operational costs. Also new buildings may be constructed during the lifetime of the network; for example, new houses are added between existing houses or larger houses are developed into apartment blocks with multiple residents. The network must be adapted to reach these new potential customers. This results in various additions and changes in the field, and in the worst case, if no spare capacity is available, network extensions with new fibres would be required.

2.2.2 Flexibility

Flexibility and accessibility has a significant impact on the costs and network operational efficiency. The following two extreme cases of a network with high and with low flexibility are discussed to illustrate the point. In reality, however, the most reasonable way of deploying the network lies somewhere in between, depending on the individual circumstances and constraints.

A network with low flexibility has a fixed connectivity at the fibre concentration points and only offers configuration options at the central office.

A network with high flexibility has several levels of fibre concentration points in the network where the fibre connectivity can be easily configured and changed over the lifetime of the network.

The network with low flexibility is a network in which the fibres of all customers are spliced from the start to the end. The splices are grouped within the fibre concentration point inside a splicing closure that could be placed inside a manhole. In such a network, even with a potential small take-rate, the communications provider must design full capacity (for 100% of the homes passed) into the network from the start. This increases the initial investment.

The network with high flexibility has street cabinets for each group of customers. The cabinet includes a mini optical distribution frame or patch panel, and fibres are connected by patch cords with connectors. Further flexibility can be introduced by deploying fibre cables that pass several houses. The connection between the cable and the houses is made when the customer is activated. The benefit of this approach is that the usage of splitters and fibre cables can be maximised, because for each active customer, the connection is established on demand, using the available free fibres or slots within the cables or enclosure. The installer can aggregate active customers onto the same equipment. As a result, even though the take rate is less than 100%, the amount of equipment required in different parts of the network can also be reduced. In other words, the initial investment can be slightly reduced.

When these two extreme options are compared from an operational point of view, there is a clear difference. In a network with low flexibility, the customer connections are already pre-installed, and as a result, the effort to activate or deactivate a customer is very low. In a network with high flexibility the operator must send technicians into the field to establish new connections in several locations. There is scope for errors if the technician makes a mistake patching the cables. Information about patches must be stored and updated in a network documentation system. Any mistake in the documentation is difficult to correct later.

There are trade-offs, however. A network with high flexibility has lower power consumption; customer connections can be aggregated, so that fewer active devices and cards are required at the central office. When new homes are built, a network with high flexibility can easily be changed so that in many cases the new customers can be covered by the existing infrastructure. For example, some additional homes can be connected to a passing cable as long as the total amount of active users on the cable is smaller than the capacity of the cable. In a network with low flexibility new splices or additional cables would be required to connect homes that were not foreseen at the design stage.

2.3 Future Migration Strategy

Network operators should plan ahead for of how the network and its capacity can be extended by new technologies in the future. The passive infrastructure is expected to last for a long time, typically at least 30 years, but the life cycle of active equipment and the evolution of the end users' requirements in terms of bit rates can happen much faster. It is important to consider the future migration strategy, so that the network could be upgraded to higher speeds with the least possible effort.

The chosen network topology will influence the effort required for a future network migration. When a point-to-point topology is used then every customer has his own dedicated fibre. This fibre can support any arbitrary transmission technology and so upgrades will require minimal changes to the outside plant cables.

A future migration is also possible within a point-to-multipoint topology, but the effort required can be much greater. Two different migration scenarios can be distinguished:

- increase the bit rates by structural changes and
- migration to a new transmission technology.

The first method is possible by reducing the splitting ratio in the splitter tree. The effort can be reduced if connectorised (plug-in) splitters are used, and if splitters are centralised.

The second way can be supported by pre-installation of key components in anticipation of future upgrades. For example, a migration to WDM-PON transmission technology can be done with less effort if WDM filters are pre-installed at the customer premises.

For the reasons mentioned, the network operator should consider the relevant future migration scenarios at an early stage of the strategic planning.

2.4 Supplier Strategy

There are two main aspects of the supplier or vendor strategy to consider:

- diversity of devices and assembly units
- interoperability

The network operator has to decide how many different types of splices, connectors, patch panels, assembly units, cables, conduits, ducts and micro-ducts should be used (and so on). The following example using micro-duct systems illustrates the problem.

There are around 60 different micro-duct systems on the market. Even within the same system, there are a variety of sizes and micro-duct configurations. On the one hand the huge variety of systems makes it possible to find the perfect system for each street. On the other hand the huge variety of systems increases the overhead costs, because each type has to be in stock. If a network operator has a stock shortage then new parts have to be ordered in case of a network failure. The result is a long time to repair.

The network operator should define at an early planning stage which devices, assembly units, cables, pipes, and micro-ducts will be deployed in the network. And closely related to this decision is the question about which suppliers will be used.

In general a specific product or product line can be purchased from one vendor (a single vendor strategy) or from several vendors (a multi-vendor strategy). The advantage of a single vendor strategy is that all systems are compatible (homogeneous system). The disadvantage of such a strategy is that it leads to dependency on this vendor. This is why most network operators prefer a multi-vendor strategy.

The best outcome from an operations and maintenance perspective is to choose vendors with products that are standardised rather than proprietary. The products should be tested prior to installation and operation to ensure that they do indeed interoperate and can be deployed at different places within the network. This simplifies operational processes in the future.

3 Network Documentation

All communications providers, whether incumbent or new network operators, have to go through the same process steps of planning, execution, and operation. The requirements for this life cycle are so complex and comprehensive that software support is required for each of the three process steps.

The network operator's objective is to ensure that the data created during the planning, design and build phases is retained so that the resulting network can be operated and maintained in an efficient manner. Without this data operational costs will increase because of inefficiencies in the operational processes.

Various methods of storing the data are possible, from a central database repository or data warehouse to a locally held GIS-based documentation of the network layers. Despite the wide range of possibilities, there are several common points which are required for efficient network design, operation and maintenance.

The following aspects will be discussed:

1. Field verification of the network design.
2. As-built documentation for network rollout and for all changes made during operation.
3. Central data management to combine resource management with provisioning and fulfilment.
4. Added value of central data management for service assurance.

3.1 Field Verification of Network Design

While it is commonplace for network designers to undertake field visits before creating the initial network design, it is less common for a field visit to take place once the initial design has been completed. This has a number of implications because, once the build is in progress, any problems with the proposed design may force changes to the design. Changes to cable routes can have an impact on the design within the current construction area, but the changes can also influence the cable routes in other construction areas, for instance, if a cable in one construction area leads over the ducts or conduit in a second construction area. In extreme cases changes in the field may completely invalidate the optimisation of a particular area.

With the wide availability of high-quality satellite, aerial and street level imagery, it is now possible for the designer to undertake the initial design from the office. High-quality imagery such as that available from Google Street View allows designers to undertake desktop surveys and create an initial design that is much closer to the final design, by taking into account the location of obstacles or placing equipment to reduce its visual impact.

Field verification of the design is still essential but, by taking the initial design out into the field, the designer can now ensure that the resulting design will minimise the changes required during construction. Tablets allow designers to take the design into the field, mark up required changes to the design with sketching tools, notes and photos. They can capture information about obstructions and possible health and safety issues quickly and easily.

Once back in the office the designer can now update the initial design to take account of the situation in the field, confident that the final design is now fully optimised for the area and should require minimal changes during construction.

Such an approach has a number of benefits:

- Faster design time as less change is required from initial to final design.
- Reduction in the number of field visits required, saving costs and time.
- Reducing unforeseen changes and their related costs during construction because the final design is more accurate.
- Faster inventory updates once the design is complete because there is less change from the final design to the as-built design.

It is also essential that every network object like a location, cable or device gets a unique ID within the entire company. As reasonable and easy as it sounds, it is a major challenge from the IT perspective and it is almost impossible to solve for large networks. Therefore it is important that a network operator decides to introduce a central data management, which creates and assigns the IDs that will be used in all applications.

3.2 As-built Documentation

Based on experience, the installed network can have a difference of up to 30% compared to the planned network. Therefore it is vital for network operation later that all changes are documented properly. The required process strongly depends on the type of the network rollout project:

At the end of a turn-key project the complete project including the documentation is handed over to the client. That means the documentation of all intermediate steps is not relevant for the client. However if the network operator is managing the project, all intermediate steps need to be documented. For example the company blowing the cables needs to know exactly which one of the micro-ducts leads to the right building. Any inconsistency between planning and installation results in mistakes, such as blowing the cable into the wrong duct, which in turn leads to delays during deployment.

Network operators often used to enter the as-built data into separate applications and the as-built database were completely independent of the planning process and the planning tool. An integrated solution (planning and documentation in one tool) simplifies and speeds up processes leading to further operational savings.

The changes between the as-built documentation and the original design can include changed cable routes, different types of material, or even new locations, which can ultimately influence the attenuation budget or the ordering of splicing. As explained previously changes occurring during construction can invalidate the optimisation performed during the design phase, resulting in unplanned costs and missed budgets. Therefore it is important to minimise changes to the design as much as possible during construction.

Reducing the amount of change also means that the as-built documentation can be updated more quickly because the change to the initial design is less. Again using tablets in the field allows the construction crews to electronically mark-up the changes they have made from the final design to the as-built network. This allows these changes to get back to the back office much faster and the master inventory to be quickly updated. This is vital to ensure that revenue generating services can be offered over the new network as quickly as possible.

Increasingly a "bring your own device" (BYOD) approach is common when construction is outsourced. Software that allows contractors to download an app and access the relevant designs and update them, either directly in the field or afterwards from their office, can significantly streamline this process. The operator's back office team can then confirm the proposed changes before accepting them into the master inventory.

Once again the benefits include faster completion of work and the creation of high-quality network documentation, which is vital for the successful operation of the network.

3.3 Central Data Management

The eTOM map distinguishes between "resource management" and "service management" which reflects the division of systems in the current IT world. Network operators typically have separate inventory management systems and systems to manage the customer services. From a resource perspective, it is not only important to know whether a certain resource is available or otherwise, but also which resources are busy and for how long.

In FTTH networks, the fundamental resource that is necessary to deliver service is the physical fibre-optic cable that connects the central office to the end customer. When a customer requests a connection, the order management and service inventory systems need to quickly find out if a physical connection is available or possible. These details can only be found in the physical network documentation, which must make this data available to other systems so that they can respond to such requests.

The approach of a central data management is to integrate the physical network documentation with order or service management systems to quickly answer the question of service availability.

Integrating the resource management and service management systems in such a combined approach is often referred to as federated inventory management.

It is also important to continue to keep the network documentation up to date while the network is in operation. Whenever customer connections are enabled or disabled, the network documentation should be updated as soon as possible to avoid degrading the quality of the data. This is critical to ensure that provisioning requests do not fail. Failed orders result in additional operational costs, loss of income, and a reduction in customer satisfaction.

3.4 Central Data Management and Service Assurance

Central data management has significant benefits for service assurance processes as well. Solutions like a federated inventory provide a cross-domain view which integrates the physical network inventory with the service inventory. A customer takes certain services, the services are routed over fibres from the customer to the central office, the fibres are part of cables, cables lead over conduits and pipes, conduits and pipes are deployed in ducts.

An integrated solution can answer questions such as: What customers and services are affected, if conduit system xyz is cut? Are there unused fibres in other cables leading over different conduit systems which are not affected, so they can be used instead? What are the required steps to use identified spare fibres for important traffic?

If data about customers and their services are combined with data about resources then it is possible to inform the affected customers about network failure or installation work that may affect the services they receive. In many cases this can be achieved before the customer is even aware they have been affected by the outage, for example by combining data from resource inventory with health indicators from the customer premises equipment.

This concept can be taken one stage further by integrating fault management systems with the federated inventory management. For example if an active device detects a fault, a cross-domain view is required to identify the faults in the passive infrastructure. There are two key aspects to this: first the customer has to be identified, and then the location of the fault has to be identified, so that a repair can be made.

Let us consider the situation where the fault is the result of a cable cut. In this case the fault management system will detect an alarm and needs to understand which services are impacted. This information can be retrieved from the service inventory. With this information the appropriate restoration plan can be implemented.

However, in order to fully restore service, the cut cable will need to be fixed. One of the key challenges is to locate the cut. The normal practice is to use OTDR (optical time-domain reflectometer) equipment to determine the distance along the fibre of the cut. When the distance is known, then it is possible to use geospatial data held in the physical inventory to precisely locate the cut in the field. This interrogation can be performed by the engineer in the field on a tablet or could be handled by an engineer in the network operations centre accessing the physical inventory directly. In a fully integrated fault management system, the system with the physical inventory returns the coordinate of the fibre cut to the fault management system, which in-turn automatically dispatches the field engineer to that location.

The main point is that accurate and up-to-date physical and service inventory data is critical when determining the impact and the location of a fault. Getting customers back on the network quickly is essential to meet service level agreements and maintain customer satisfaction.

3.5 Summary

High-quality network documentation is an important part of efficient network operations and maintenance. The cost of maintaining network documentation should be considered in the context of more efficient network design, construction and operations. In those contexts the relatively modest amount of expenditure required can result in significant savings through faster and more accurate designs leading to reduced overruns during construction and more efficient network operations.

Of course not all network operators are able to change their IT system completely, therefore central data management concepts allow different specialised solutions to be deployed and integrated. Further detailed information about the efficient use of tools for planning and operating access networks can be found in [1].

In conclusion, efficient operation and maintenance is only possible when the network that has been thoroughly documented and the documentation kept up to date.

4 Standardise and Streamline OAM Processes

This chapter addresses the importance of process management in supporting FTTH network operations and maintenance. It will take into account the opportunities (and risks) associated with process management and highlight some common approaches applied by network operators. Special consideration will be given to the disciplines of FTTH network build, fulfilment and assurance. More detail on this subject can be found in [2].

4.1 Introduction to Process Management

Network operations and maintenance is a "big ticket" item with operators typically devoting around one third of their total operating expenditure to such activities. Add to this the huge capex budgets being spent on network build projects and it soon becomes clear how significant these "build and maintain" processes are in determining an FTTH operator's current and future profitability. As further cost savings and productivity gains becoming increasingly harder to find, greater scrutiny is now being placed on these activities.

Process management is increasingly gaining favour over historical cost-cutting exercises - no doubt because it is more objective. Furthermore, process management offers a methodical approach to identifying specific problems such as bottlenecks and non-value-add activity (waste), etc.

Many different terms are used to describe process-based management approaches; for example: business process re-engineering (BPR) and business process management (BPM) to name just two. Whilst such terms are not identical, they do largely overlap and are used interchangeably within the industry (meaning one person's BPR project might well be another's BPM project). This chapter does not attempt to explain the subtle differences between the various terms; rather we will use the generic term "process management" to broadly describe all such approaches and methodologies (such as TQM, Six Sigma and Lean, etc.). These approaches can be considered subsets of the broader concept of process management.

It is also worth briefly mentioning where the TM Forum's Business Process Framework (eTOM) sits in relation to this discussion. Here we focus on discussing some of the main principles of, and approaches to, process management. In contrast, eTOM is a specific process model for the telecommunications industry. This chapter can therefore be considered complementary to eTOM (and other industry models for that matter). It should also be relevant to operators who have decided not to adopt eTOM.

Naturally, the overall concept of process management continues to evolve, driven by changes in technology, resources and the business environment. However, its basic value proposition has remained unchanged for decades; namely, to process more with less effort and of a higher quality. Process management will therefore no doubt remain a cornerstone discipline for network operators who are looking to grow whilst containing costs.

4.2 Process Management Adoption

Whilst process management is a well-established managerial discipline across most major industries, many network operators have been slow to embrace it - and have therefore largely forgone the benefits that such an approach offers.

This is particularly evident in developing economies where many operators have tended to favour a labour-intensive approach to building and operating their networks. Whilst often described as short-sighted, it is easy to understand why operators largely rely on cheap labour to compensate for shortfalls in their planning and execution capabilities. Inevitably it will take time for these operators to mature in their thinking and grasp the process opportunity. Of course, operators in developed economies don't have the luxury of working in such an "inefficient" manner and it is therefore no coincidence that process management adoption has been much higher in these more mature markets.

However, process management adoption is not a trivial undertaking for a network operator and a number have questioned whether they are mature enough to make it work. Whilst their concerns are undoubtedly valid, ironically it is these same (less mature) operators who stand to benefit the most. When implemented correctly, process management helps to compensate for a lack of organisational capability and experience. Being prescriptive, it clearly explains what needs to be done and removes individual guesswork. It is therefore a highly effective training tool for operators needing to upskill their workforce and mature their company culture.

4.3 A Model for Change

A popular paradigm for driving process improvement is the 'As-Is' to 'To-Be' approach. 'As-Is' is the process as it currently stands; whereas 'To-Be' is the target process after it has been re-engineered. The operator then builds a bridge from the current 'As-Is' position to the desired 'To-Be' outcome via a series of changes. These changes may be small and relate directly to the process, or they could be holistic changes that assist in achieving the bigger picture. Examples include changes in responsibility, backfilling positions, automating tasks, changing structures, etc. It is also worth remembering that company culture is as relevant as the tasks and resources that the process utilises.

The beauty of this approach is that the required changes can be broken down into small manageable pieces and completed over a period of time. Each change is a step in the right direction and this type of iterative approach also sets the foundations for continuous improvement. Employees become used to the culture of ongoing change and the pursuit of improvement becomes ingrained in the company culture.

4.4 Process Standardisation

The importance of process standardisation for network operators cannot be underestimated. Process standardisation is of most value in regulated industries with high-volume, repetitive processes that move amongst a number of different individuals during their lifecycle.

Given the fact that the majority of a network operator's activities fit this scenario – especially in deployment and operations - process standardisation is key to delivering a consistent customer experience and improving productivity. It is also a precondition for fast and efficient workflows.

As with any process, if more than one individual completes a task without any parameters in place, then it is likely that more than one method is being used. Collaborative process standardisation results in more consistent output, better training and where industry regulations must be enforced, provides assurance around company compliance.

As an example, consider an FTTx rollout where a network operator is monitoring the cost-per-premise passed. Invariably the build cost for the most expensive 10-20% of premises far exceeds the average. However, whilst some incremental costs are no doubt unavoidable (due to physical factors such as lower population density, etc.), others are often caused by a breakdown in the process itself.

Without standardised processes, the operator is unnecessarily accentuating the cost per premises passed by allowing inefficient variations to become part of daily activity. By standardising the processes inherent in the FTTx rollout, variations reduce and productivity increases. Standardisation ensures that there are robust processes in place and that they are embraced.

4.5 Standard Operating Procedures

A Standard Operating Procedure (SOP) is a document that outlines the steps required to complete a particular process. A SOP takes the uncertainty out of a process and means that employees and contractors have a clear directive to follow.

A SOP should cover both operational and support processes, with the procedures for each core process mapped from start to finish. Ideally, the processes are mapped by those who already undertake the process, but the process should be simple and clear enough to be followed by most. Generally, diagrams and visual depictions are preferred over overly technical, verbose explanations.

A SOP defines what needs to be done, when and by whom. It also defines how the process will be measured and who is responsible for achieving that measure. Without a SOP, employees have no clear guidance around how a task should be completed, and ad hoc processes and personal preferences/habits filter into the operational equation. This scenario can be more likely where staff are spread over many different locations or where contractors form a large part of the labour force.

4.6 The Impact of Outsourcing

With more network operators outsourcing more of their activities to managed service providers and third-party contractors, outsourcing is having a big impact on the industry. This is especially true with build, operations and maintenance processes which are the most frequently outsourced.

However, the belief that outsourcing somehow negates the importance of process management is ill-founded. In fact, as the number of contractors and/or outsourcing parties employed by the operator increases, so too does the complexity of the operating environment.

Even with managed service providers in place, accountability (and therefore overall process ownership) ultimately remains with the operator. So, whilst outsourcing clearly changes the operating model, it doesn't remove the need for disciplined process management. In fact, as many network operators have slowly realised, process management actually becomes more important in such situations.

Such misconceptions no doubt help to explain why many network operators have failed to achieve the anticipated financial returns from outsourcing.

Many have seen outsourcing as a way of getting rid of their problems, without first fixing them. Unfortunately, such problems not only continue to exist, they are actually accentuated by the fact that the more parties involved, the more complex the operating model.

Common causes of outsourcing failure include:

- incongruent and subjective goals
- misunderstanding of the process
- lack of standards
- inadequate reporting and transparency
- unclear division of responsibilities

Outsourcing therefore presents its own set of unique challenges and process management has a critical role to play. It is both a planning and execution tool and helps the parties clearly define robust operating and business models that are grounded in reality.

4.7 Logistics and Inventory Management

Logistics and inventory management are also vital components that must be integrated into an operator's core processes. Once the network equipment supplier agreement is in place, attention must move to the logistics for ordering and delivering the required materials to site. This must be tightly coordinated with the workforce management process in order to ensure the technicians have access to the correct materials to complete the work.

For the network operator, it is fundamentally about ensuring that both the key personnel and network inventory are available and present on site at the right time. Failure to ensure that the equipment is at the right location at the right time will inevitably mean wasted time and effort for technicians who are ready to complete a scheduled task but lack the equipment to do so. This in turn can have ongoing repercussions for scheduled work timetables and deadlines. Process management is therefore essential in coordinating workforce management and logistics management.

These issues can be avoided by establishing an integrated, end-to-end supply chain, which, with the right expertise and tools, can in turn drive efficiency into the delivery of services and remove significant cost from the value chain. Workflows therefore need to be tightly integrated from an inventory and workforce point-of-view.

4.8 Enabling Process Management with Software

The power of software to support operators' process management initiatives is well established. In fact, very few processes can be considered even close to optimal without the use of software to manage and report on the process.

Once a process has been standardised (to the agreement and satisfaction of all key personnel) and documented, it can be replicated in the software. This means configuring the software to match the operator's desired workflow. The implementation should also extend beyond the network operator to include contractors in order to create the collaborative environment critical for success. The software then helps to manage, measure and report on the process.

Many process steps will be able to be automated based on software-defined business rules and automatic data-capture forms the foundation for powerful reporting. Here the data can be used to provide automated real-time reporting of key measures. This in turn supports rapid decision-making by all stakeholders – those undertaking the process, those monitoring the process and those responsible for its outcome.

The software also helps to support process standardisation by establishing controls that ensure adherence to the prescribed workflow.

The use of software minimises the amount of effort needed to perform, manage and report on operational processes. It is therefore a critical enabler for operators looking to leverage the full value from their process management initiatives.

4.9 Process Measurement

Effectively measuring a process ensures that it is delivering to the agreed standard and improving over time. But with so many different possible options, careful consideration needs to be given to implementing the right measures.

Generally speaking, this means establishing a small, balanced set of key performance indicators (KPIs) that helps to answer the following key questions:

- How effective is the process?
- How efficient is the process?
- How agile is the process?

Most operations and maintenance processes will therefore require a handful of different measures that can be assessed together in order to strike the right balance between speed, cost and quality of service.

4.10 Summary

Process management can be a powerful tool for network operators needing to lower their operations and maintenance costs and improve service performance. It allows operators to deliver more with less: to improve output (both in terms of quantity and quality) with less input (and therefore lower costs).

5 Conclusions

This white paper identifies three important issues that have an impact on the efficiency of FTTH network operations and maintenance:

1. **Strategic planning** at the start of a project can minimise the effort required to operate and maintain the network later. The deployment strategy can be optimised to enable more efficient network operations and maintenance. Clear network design rules are required. Considerations include the provision of spare capacity for network additions and extensions, the required flexibility and accessibility of cables and conduit, and the future migration strategy. Finally, the number of suppliers and the variety of equipment deployed in the network has a strong impact on the complexity of maintaining the network.

2. Well-maintained **network documentation** is important to keep the network manageable, avoids unnecessary errors and outage times in case of repairs, and overall saves time and cost during the network operation and maintenance phase. To create and maintain high-quality documentation is an important but challenging task. Software tools are indispensable; some can collect data in the field and enter those details directly into the as-built documentation for an up-to-date record. With a centralised data management system, inconsistencies between different teams and data sources can be avoided, which improves the service performance of the network.

3. **Standardised process management** provides a set of proven and effective practices to support network operations and maintenance in a systematic way, while increasing the efficiency of all related procedures and tasks. Further aspects, such as inventory management and process measurement are taken as relevant component to support the whole process management approach. It is also possible to apply a tool-supported process management to make the implementation sufficient.

These three approaches have been applied and proven to be effective by a number of FTTH network operators in different countries around the world.

This is not meant to be an exhaustive list of the main factors affecting FTTH operations; we anticipate that there are more ways to improve the efficiency of FTTH network operations and maintenance, and we hope that this white paper will stimulate an open discussion on this subject. To contribute to the discussion, please contact the Deployment & Operations Committee via email: info@ftthcouncil.eu.

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