DUTCH DATA CENTER ASSOCIATION

Rentaload
Load bank rentals leader

VERTIV.

unica
datacenters

Deerns

TÜVIT®
TÜV NORD GROUP

— 2020

Data center
Commissioning guide

Why professional commisioning is key for quality, sustainability and time to market while maintaining continuous growth in digitisation

Content

1. THE DIGITAL ECONOMY **IS THE ECONOMY**

1. Everything is data driven

Everything is data driven

The world is rapidly changing due to digital transformation

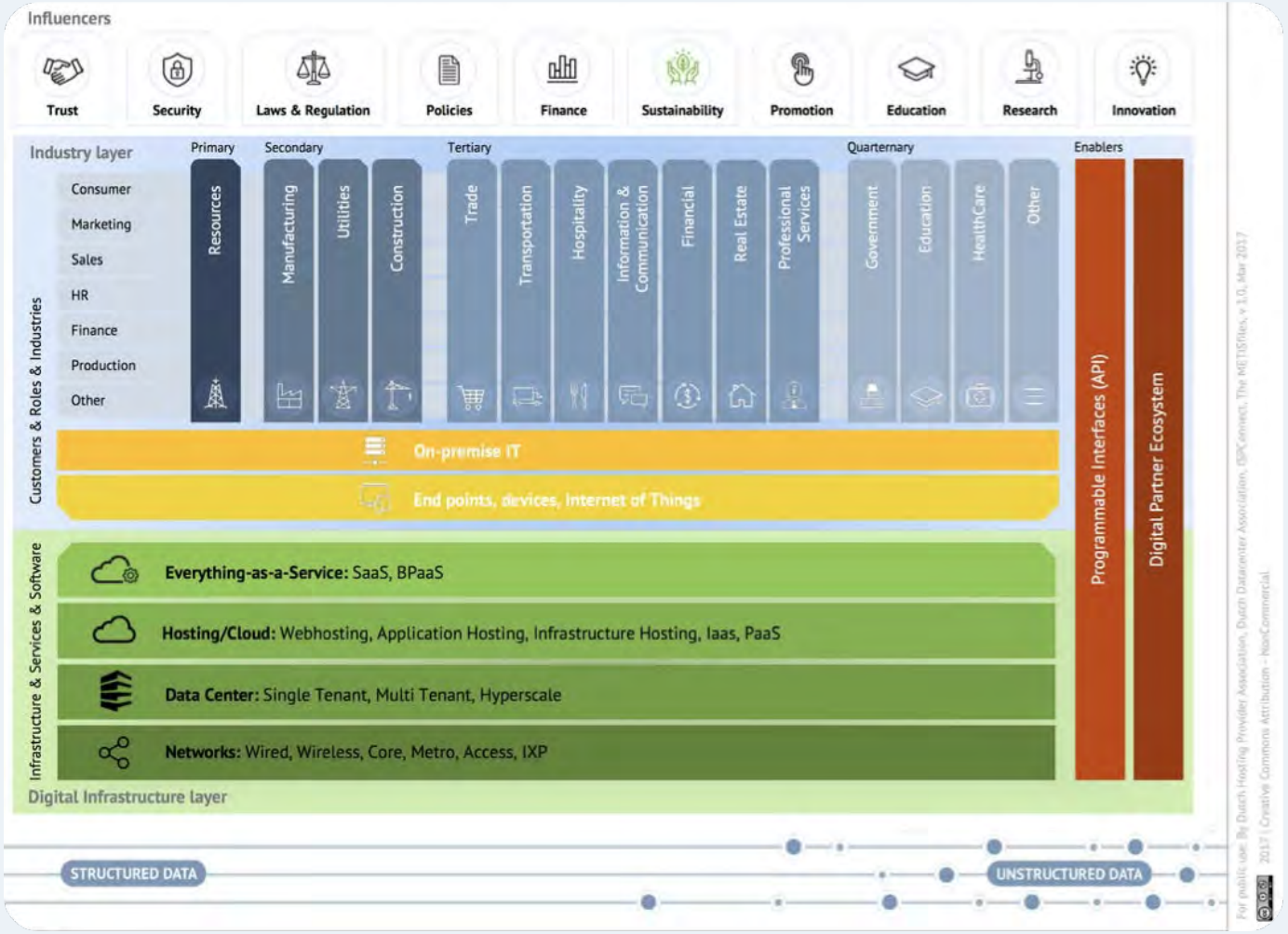
Data driven ● Smart ● Share ● As a Service

1. The digital economy is the economy

More and more revenue through digitisation: top priority to go along with

By 2022, more than **60%** of global **GDP**[1] will be digitized with growth in every industry, driven by digitally enhanced offers, operations and relationships.

Management of each organisation must place digital transformation at the top of their priority list. All that happens online originates from data centers.



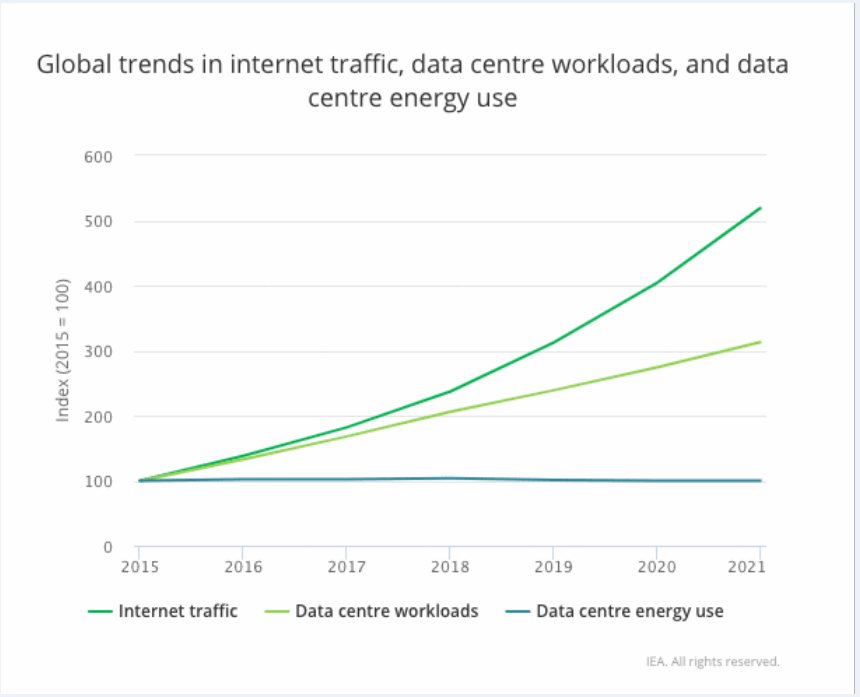
1. Growth in data centers is inevitable

Digitisation puts more trust in data centers

The **ever-increasing digitization** of our society and economy requires more and more data centers. The speed in digital transformation is putting pressure on the delivery of new data centers.

We need the growth of data centers to also control the use of energy. **Centralizing IT in data centers saves energy**: Cloud computing brings much better utilization of computer power next to the increased efficiency in running the data center facilities.

To ensure the quality of new data center facilities while speeding up and inproving the building process at the same time requires professional **data center standards**.



Despite the enormous growth in data, energy consumption has remained stable worldwide

2. COMMISSIONING, BENEFITS & PROCESSES

2. Data Center Commissioning

Commissioning has now become a business necessity

When building a new data center, the owner of the data center has no guarantee that the various physical infrastructure subsystems – power, cooling, fire suppression, security, and management – will work together. Commissioning is the process that reviews and tests the data center's physical infrastructure design as a holistic system in order to assure the highest level of reliability.

Traditional commissioning is a daunting task. Since formal system operation doesn't begin until the system is commissioned, the commissioning team experiences intense pressure to complete the commissioning process quickly. Commissioning can involve high expense and requires staffs from different departmental disciplines to work together. For these reasons data center commissioning has almost uniquely been associated with large data centers.

In the recent past, many data center managers chose to roll the dice and perform little or no commissioning, relying only on start-up data to press ahead with launching the new data center. Given the reality of 24x7 operations, however, the alternative of exposure to major system failures and accompanying downtime is no longer an economically viable option. Commissioning has now become a business necessity.

"Commisioning is verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the needs of the owner."

2. Data Center Commissioning

Commissioning definition & objective

Commissioning definition

Commissioning is the process of assuring that all systems and components of a building or industrial plant are designed, installed, tested, operated and maintained according to the operational requirements of the owner or final client.

Commisioning or simply abbreviated as "Cx"

Commissioning objective

The main objective of commissioning is to affect the safe and orderly handover of the unit from the constructor to the owner, guaranteeing its operability in terms of performance, reliability, safety and information traceability.

Additionally, when executed in a planned and effective way, commissioning normally represents an essential factor for the fulfillment of schedule, costs, safety and quality requirements of the project.

2. Benefits of commissioning

The benefits of tests & commissioning

Commissioning highlights what a system can do and how it will respond beyond the original requirements and design features.

It provides a baseline for how the facility should perform throughout the rest of its life and affords the opportunity for operations to become familiar with how systems operate and to test and verify their operational procedures without risking critical IT loads.

The commissioning process also determines the performance limits of a data center and helps optimise the data center systems.

Failure to properly commission a data center leaves the door wide open for expensive and disruptive downtime that could have been avoided.

Key focus on 3 critical phases:
Cooling systems, Air Flow direction, Power system

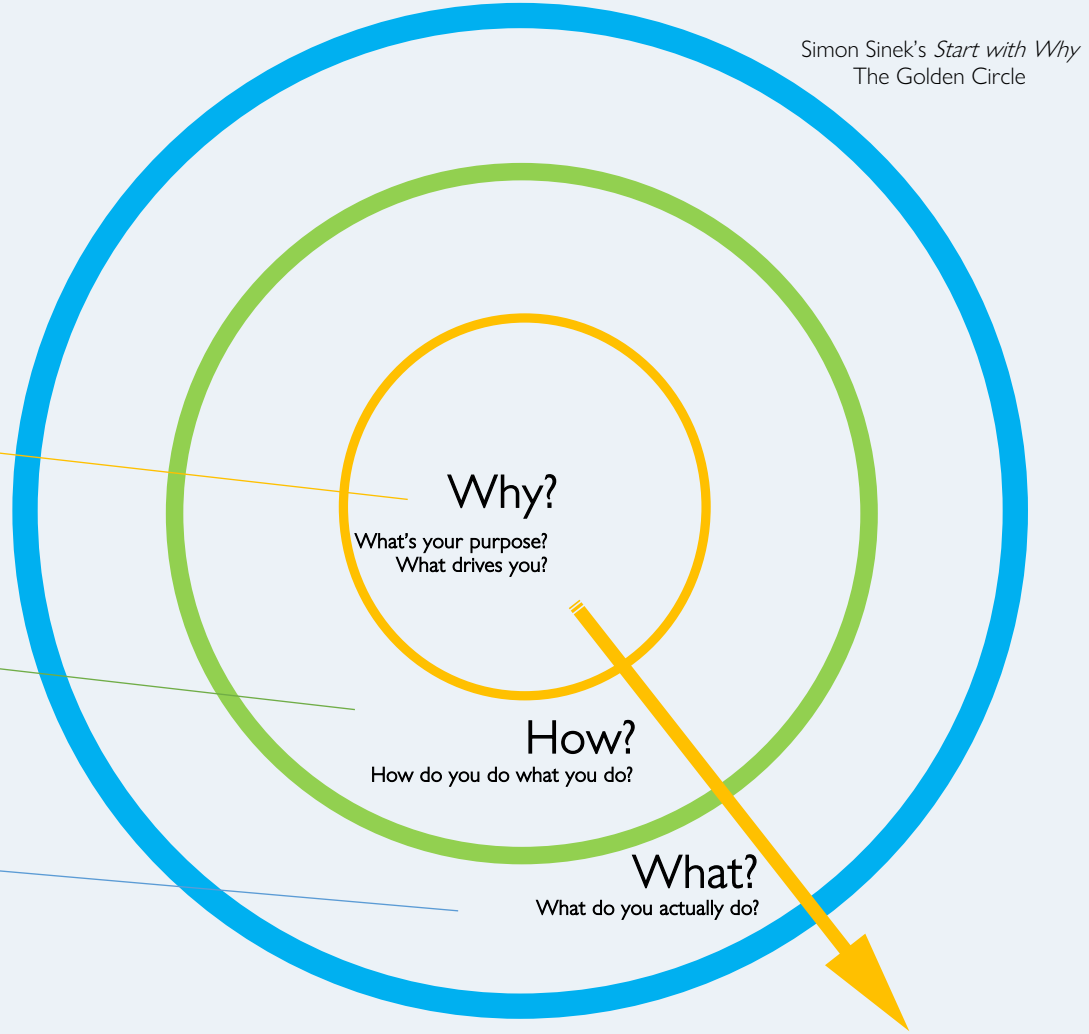
2. Concept data center

ISAT Commissioning

Why?
Compliance, Proof of evidence, Guarantee, Liability
Customer and/or stakeholder driven and regulations
Owners delivery standards (Stress test / punches)

How?
Detailed planning
Testing and inspection phases
Acceptance and Handover

What?
Critical infrastructure including full load tests
Building management systems
Facility / operational processes



2. Commissioning process

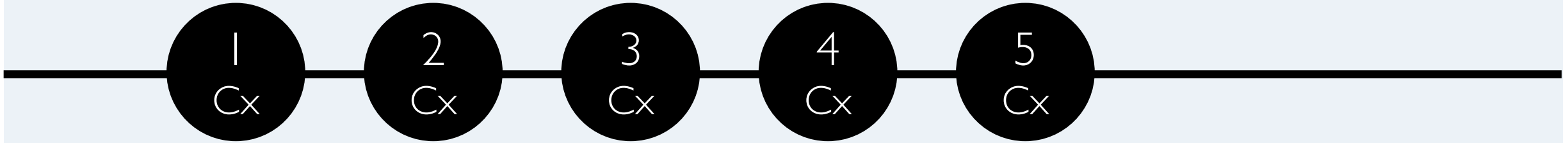
The different commissioning steps

Data center commissioning can be categorised by different steps:

- Design input — Sometimes referred to as Cx Level 0

1. Cx Level 1 — Factory Acceptance Testing (FAT)
2. Cx Level 2 — Installation Testing (Dead test)
3. Cx Level 3 — Startup Testing (Live test)
4. Cx Level 4 — Functional Performance Testing (SAT)
5. Cx Level 5 — Integrated System Testing (IST)

- Training — Before and after handover



2. Commissioning process

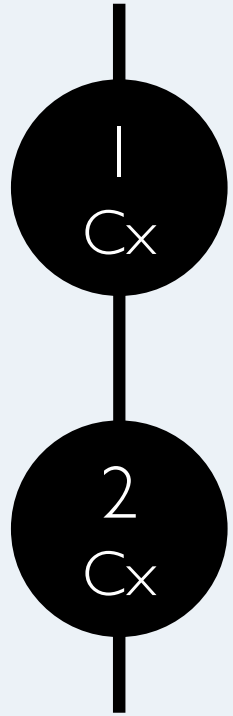
Cx Level 1 and 2

Cx Level 1

- Factory Acceptance Test (FAT) including witnessing and reporting
- Off site software testing including graphics logics and communication
- Verifying factory QA/QC

Cx Level 2

- QA/QC of equipment and building (snagging/punching)
- Visual inspection
- I/O testing cabling
- Pressure testing piping
- Electrical pressure testing, primary and secondary injection testing, verifying discrimination settings, dead testing cables
- Pre-start (supplier) checklist completed and documented



2. Commissioning process

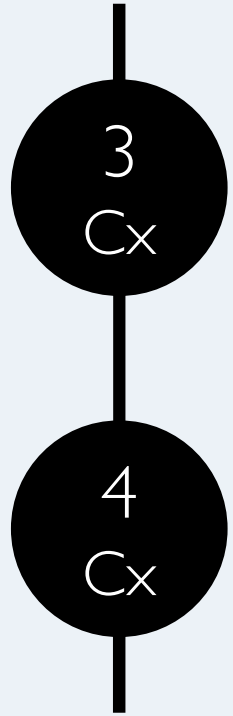
Cx Level 3 and 4

Cx Level 3

- Energizing
- Equipment start-up by vendor or main contractor
- Verification and documentation of settings
- Point to graphic

Cx Level 4

- Full functional testing
- Full performance testing
- Balancing of systems
- Testing of interfaces, including controls
- Testing of failure conditions
- Full (heat) load testing



2. Commissioning process

Cx Level 5

Cx Level 5

- Integrated System Testing (IST):
    - Integrated performance testing
    - Redundancy testing
    - Black Building Test (BBT)
    - Total Power Outtage Test (TOAT)

2. Toolbox

Toolbox for commissioning management

- Define roles and responsibilities
- Design freeze and change management
- Planning
- Cx Meetings
- Proper documentation (test scripts) and sign-off
- Snag - open items control
- Safety system (work permits)

2. Toolbox

Define roles and responsibilities

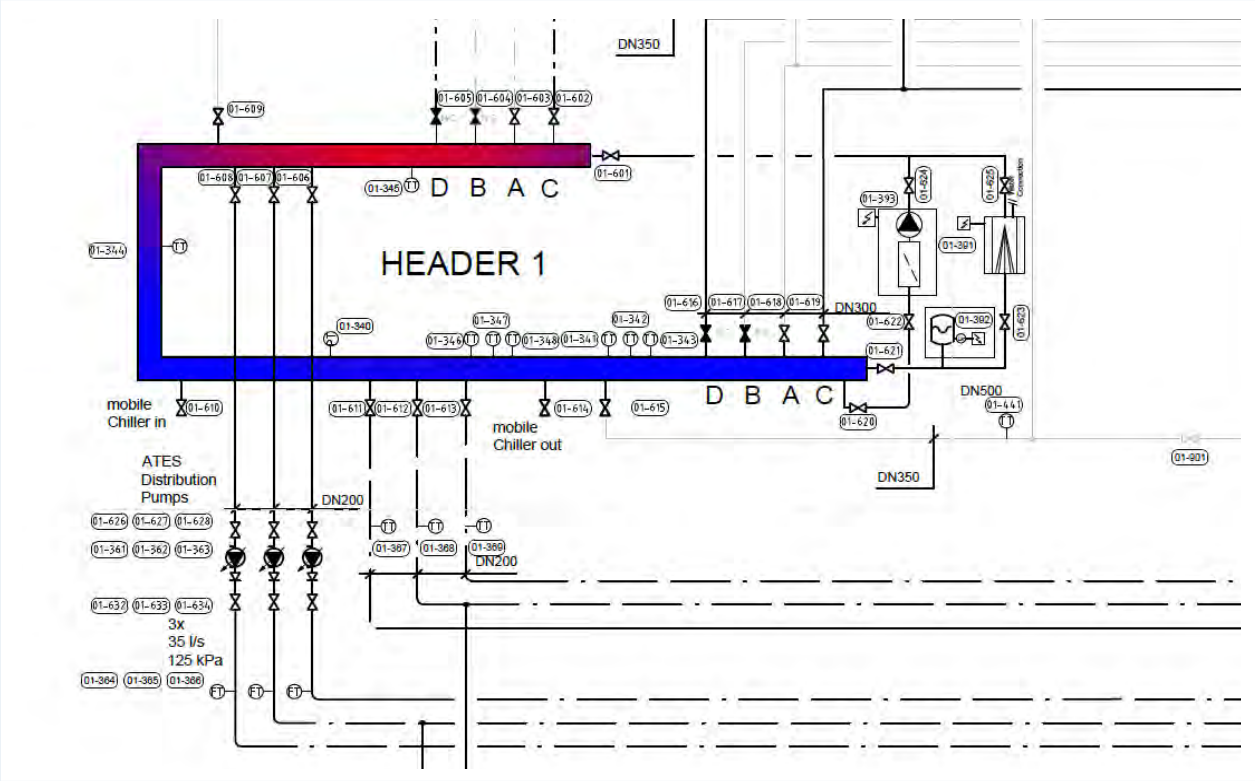
- Main roles (high level)
  - Owner — Customer
  - Contractor — Main Contractor
  - Cx Agent — Commissioning agent
  - A/E of Record — Architect/Engineer
  - Vendor — Subcontractor / ESSP

		R= Responsible A= Accountable S= Support I = Informed C= Consulted					
Product	Product Description and Form	Phase 1 Scope Description					
		CA	A/E of Record	GC	Subs	Owner	Vend
QA/QC Plan	Identify 'First in Place' reviews and integrate with project schedule. Track on log and achieve signoff	R	C	S	S	A	NA
Level 3 Pre-functional Checklists	Develop checklists for each piece of equipment representing a fully installed – ready for testing item	A	C	R	S	I	S
Deficiency Logs	Develop and maintain a weekly log of project deficiencies and drive completion	A/R	S	S	S	I	S
Acceptance Testing	Document, maintain and turnover all testing paperwork, ie. Pipe pressure tests, NETA docs, chemical treatment, megger tests etc.	A/R	I	S	S	I	S
Cx Meetings	Scoping & Coordinating meetings and providing minutes to document progress	R	I	A	S	I	I
Cx Plan	Final Cx plan for construction phase	R	C	C	S	A	S

2. Toolbox

Design freeze and change management

- Proper tagging and coding of components
- Single line drawings
- P&ID
- Technical queries

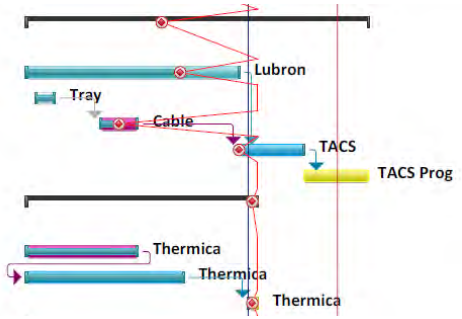


2. Toolbox

Planning

- Commissioning plan
- Project schedule including commissioning
- Progress reporting

103		**Lakos+ADF Watertreatment D (M+E)**	**51% 27 dagen**	**maa 29-5-17**
104		Installation	75% 17 dagen	maa 29-5-17
105		Cable tray	100% 2 dagen	din 30-5-17
106		Cable works	50% 4 dagen	din 6-6-17
107		Level 2	0% 5 dagen	woe 21-6-17
108		Level 3	0% 5 dagen	woe 28-6-17
109		**HDC 5 1D 201 AM4-12.01-CMS-12CC-9.13**	**97% 19 dagen**	**maa 29-5-17**
110		Cabling on HDC	100% 10 dagen	maa 29-5-17
111		Control Cabinets	100% 13 dagen	maa 29-5-17
112		Software test per 3-units	25% 1 dag	don 22-6-17



2. Toolbox

Cx Meetings

- Join monthly (?) meetings during the design phase
- Join weekly meetings during the construction phase
- Daily Cx meetings during the commissioning phase

Cx Documentation

- Commissioning plan
- Test method statements
- Vendor test sheets
- Visual inspection sheets
- I/O check sheets
- Instrumentation sheets
- Ready for energization sheets
- IST test script

2. Toolbox

Snag - open items control

- Snag - open items control
- Snag list (ED Controls)
- Issue Resolution Log (IRL)
- Including search functions per system or area
- All items should have a weight (priority)

Safety system (work permits)

- Site safety culture
- Work permits when systems are live
- Lock Out Tag Out (LOTO)
- Access control

2. Commissioning process

Steps to success

Step 1: Integration with the design

The ability to commission equipment should be considered at the earliest stage of every project. Building in a commissioning schedule into the program, sequencing how you will access equipment during the build process is essential. Time spent considering logistical challenges will be handsomely rewarded with seamless integration throughout the build program.

Step 2: Planning

Get your technical services teams engaged at the outset - providing their input and insight into the design of buildings services at the initial stages where they can help develop a comprehensive schedule of the testing and commissioning process. Make the testing regime system simple, efficient and standardized - and most importantly transparent, so that commissioning is readily tracked and recorded centrally with a documentation output.

Don’t assume that technology will solve all challenges. Documentation is often grouped and not produced progressively resulting in the late release of vital documents and project delays. A comprehensive plan must include a phased schedule and record of necessary documentation.

2. Commissioning process

Steps to success

Step 3: The factory acceptance test

Never make assumptions that products and systems will operate seamlessly unless you have the hard data to back this up. Not all products undertake a witnessed factory acceptance test, so unless you have verified data that you can successfully integrate these within your network, then you must validate compliance before installation begins. Costly and time-consuming issues can be avoided with a thorough interrogation long before any product arrives on site.

Step 4: Visual inspections

Sounds simple but it's so often overlooked on a busy site. Make sure that any delivered equipment is visually inspected for signs of damage. Any defects should be immediately reported, and a swift resolution sought. Smart tags should be fixed to equipment to provide the unique identification of equipment and associated commissioning data during construction and post-completion.

Step 5: Site acceptance testing

Each product and service should be physically and independently tested on site to verify performance criteria and ensure alignment with the design and specification. This is considered as the SAT (Site acceptance testing). Remember, the physical testing operation is not synonymous with the release of the testing documentation, which needs to be independently tracked to ensure the process is completed.

2. Commissioning process

Steps to success

Step 6: System operation verification

Data networks are at the heart of data center systems. All data transmission networks are to be independently certified ahead of any joint systems testing to ensure the communication between equipment is functional. The isolation and certification of these networks is the precursor to full operations testing, but it's easy to get this sequencing wrong and create needless delays.

Step 7: Integrated system testing

The final integrated system test is the opportunity to observe the performance of a data center at maximum design load. Absolute rigor and attention to detail is fundamental at this stage, measuring and accurately recording switch positions, environmental conditions and failure scenarios to ensure operational compliance. Efficient progression to this stage marks the operational handover of the data center.

Changing the conversation with customers and key project stakeholders about the importance of commissioning is pivotal if you want to meet expectations for faster, day one operational data center facilities.

By identifying those critical pathways and processes that can have the most detrimental impact on program, one can enhance project collaboration to deliver a better outcome. As technology advances, we can expect to see dynamic live reporting fall within our arsenal - however our adage will always remain the same - ignore the importance of commissioning at your peril.

3. BEST PRACTICES AND CASES

3. Best practices & cases

Rentaload – The wind rose

Allocate necessary budget upfront to support all aspects of commissioning

- Commissioning budget should include large contingency reserve for Level 4 and Level 5
- Commissioning budget should include all items and personnel required to support complete commissioning

"Budgets need to include all items and personnel required to support commissioning. This includes, but is not limited to, load banks, calibrated measurement devices, data loggers, technician support, engineering support, and consumables such as fuel for engine-generator sets."

3. Best practices & cases

Rentaload – The wind rose

Fully test all critical components and systems

- Load bank tests of the engine-generator sets, UPS, and UPS battery systems at design and rated capacities
- Minimum continuous runtime durations of up to 24 hours for all load bank tests
- Ensure that load banks are distributed within critical areas to best simulate the actual IT environment distribution, ideally physically located within racks and with forced cooling on a horizontal path, which allows for more accurate and realistic mechanical system testing

3. Best practices & cases

Rentaload – The wind rose

Focus on integrated test, the most informative and representative test

- Size load banks as small as reasonably possible for Level 5 activities to best simulate the actual IT environment for more accurate and realistic mechanical system testing
- At a minimum, take electrical load and critical area temperature readings between each discrete test; where data loggers are used, measurements should be logged every 30-60 seconds
- Test a variety of load conditions—10%, 25%, 50%, 75%, and 100% step loads—in order to simulate the actual load conditions as a datacentre gradually increases its critical IT load
- Install aisle containment strategies that are to be utilized as part of the design to ensure the aisle containment strategies support the infrastructure as required

" Datacenter systems may be simple, but their interaction isn't. Level 5 testing verifies reliability of design and compatibility among all critical systems (Electrical Mechanical, Environmental). You must test in all modes (Failure, Safety, Emergency)."

3. Best practices & cases

Rentaload – The wind rose

Continuously improved the process using new technologies

- Use smart load bank that can be connected to a supervision software that can run the whole fleet in different mode (load, switch from lane A to B, etc.)
- Choose load banks that are capable to be feeded 50%-50% so to precisely test 2N configurations
- Benefit from 3D software modelization to see on-live & to record all datas captured during the test (P, U, I, T° on the load banks or in the room)
- Gather information on dedicated data base to prepare I.A. operation support

3. Best practices & cases

Vertiv - Best Practices for Critical Facility Commissioning

When it comes to designing, building, and implementing critical operating systems, the commissioning (Cx) process plays an instrumental role in ensuring facility owners realize the greatest possible return on their investment. But like any other task, getting the most out of the Cx process depends on what you put into it.

That said, Cx in no way needs to be an all-consuming or complicated ordeal for a facility owner. However, it is wise for the owner to put the right person in charge of the process. In doing so, and adhering to a handful of industry best practices, owners, managers, and operating staff can launch a Cx program that more than pays for itself through systems that operate as intended, and a design/build process that stays on time and on budget. Here's how to get the most from the Cx spend:

1. HIRE THE RIGHT COMMISSIONING AUTHORITY (CxA)

Owners rarely have the time to oversee all aspects of the Cx process. That's why they hire a CxA. The right CxA can provide the guidance and advice an owner needs to make informed, strategic decisions throughout the process. The intent of the organization serving as the CxA is to deliver the facility, program, modification, or expansion while ensuring that meeting the needs of the owner is the top priority.

To avoid conflicts of interest, your CxA should be independent, especially from your general contractor and design consultant. Ideally, the CxA should be under direct contract to the owner, have a direct line of communication to the owner, and have no other project responsibilities other than Cx activities.

Owners also want to make sure the CxA has the right credentials, such as experience Cx critical spaces or mission-critical facilities. If possible, work with a CxA who is certified as a Qualified Commissioning Process Provider (QCxP) with training in Cx guidelines from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Ideally, your CxA will also be involved with major industry associations, such as the Building Commissioning Association (BCA) and InterNational Electrical Testing Association (NETA).

3. Best practices & cases

Vertiv - Best Practices for Critical Facility Commissioning

2. COMMIT TO THE PROCES

The CxA will take charge of all the day-to-day Cx responsibilities. But owners can make that job a lot easier and ensure everyone else is on board by being an engaged participant. In fact, the owner's involvement and attitude will set the tone for all other participants. If owners make it clear that Cx is a priority and take an active role in authorizing activities, then it's more likely the design team, general contractor, subcontractors, and equipment vendors will follow suit and be willing to collaborate to complete Cx activities per the project schedule.

3. TAKE A COMPREHENSIVE APPROACH TO Cx

In practice, many facility owners only engage in Cx activities during the construction phase of their projects. They limit the scope of Cx to focus on acceptance testing, equipment startup, and similar services that occur once the system or assembly has been built. As a result, they miss out on much of the value that a broader approach to Cx provides. If limited to the construction phase of the Cx process, the CxA can only impact site responsibilities. Involving the CxA earlier in the project, allows for a review of the design documentation to ensure what is given to a potential general contractors or vendors is an accurate representation of the full scope of work, rather than leaving it open to interpretation. This also allows accurate proposals from competing vendors to support the procurement, installation, and operation of a new or existing facility; ultimately resulting in a reduction in change orders or schedule delays, and closer alignment to the dictated project schedule.

Many experts recommend engaging a CxA even before a design team or engineering firm. A properly vetted CxA will be an expert at helping owners articulate their requirements for the data center and will assist in creating the Owner's Project Requirements (OPR). This critical step ensures that what the owner needs and expects from their investment becomes the foundation upon which all subsequent activities are based. In other words, everything from system design, to construction, to operation schemes will map back to the OPR, helping to ensure the owner's ultimate satisfaction and return on investment (ROI).

3. Best practices & cases

Vertiv - Best Practices for Critical Facility Commissioning

4. PRIORITIZE THE BUDGET

While the entire facility and all of its systems and assemblies can likely benefit from Cx, the budget will only stretch so far. That's why owners will want to work closely with their CxA to determine which activities will deliver the greatest ROI based on the OPR. From enabling facility availability, to promoting safety and compliance, to ensuring energy efficiency, a CxA can guide owners in specifying and scheduling the Cx services that will best meet their needs—yet another good reason to get the CxA involved early.

5. DON'T OVERLOOK THE POST OCCUPANCY PHASE

Just as early CxA engagement is a good idea, so is keeping the CxA onboard for the duration of a project. It is not until construction is completed and the project if fully operational that the CxA can truly validate that systems are operating in accordance with the OPR. At this time, the CxA can oversee any fine-tuning, deferred testing, or system optimization, as well as conduct the warranty review to make sure that critical infrastructure is primed to meet the owner's specific project needs for years to come.

At its foundation, Cx is all about ensuring owner satisfaction. By hiring the right experts and committing to a comprehensive Cx process, owners can rest assured that their facility or system will operate exactly as intended.

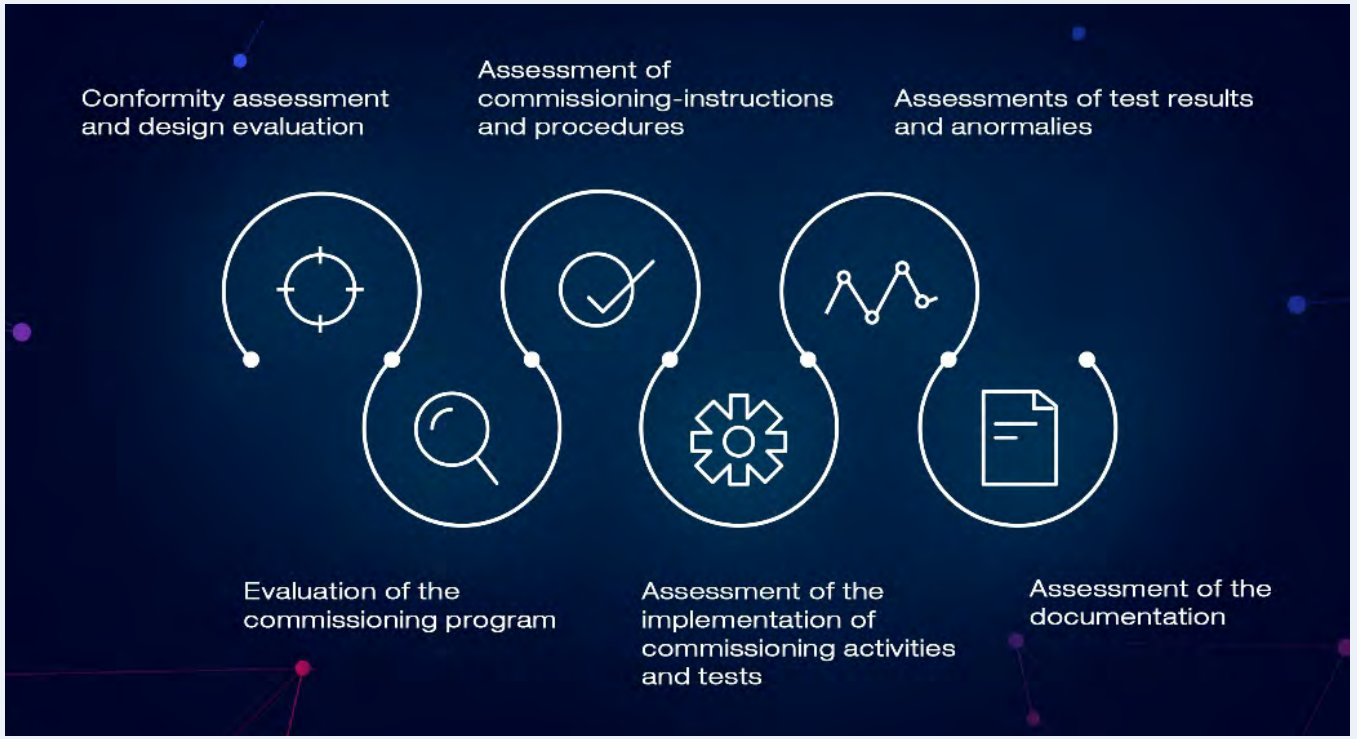
3. Best practices & cases

TÜViT - Quality Assurance during the commissioning

The commissioning, which is prepared and carried out in a structured manner, requires comprehensive quality assurance in order to obtain reliable and meaningful test results, guarantee successful completion and provide evidence that the contractually agreed availability level, e.g. TSI (Trusted Site Infrastructure) Level 1-4, has been reached. The assessment of any identified deviations is essential.

Quality Assurance Steps

The following steps are useful and necessary for a comprehensive quality assurance:



3. Best practices & cases

TÜViT - Quality Assurance during the commissioning

Conformity assessment / design evaluation (as offered within the framework of TSI or the EN 50600)

As part of the conformity assessment or designevaluation, the planning documents, e.g. mechanical and electrical systems, are used to evaluate whether and how the data center or the supplying data center infrastructure reaches the intended availability level/class.

In addition, the result of the assessments represents the basis for the following tests and quality assurance steps.

Evaluation of the commissioning program

The commissioning program is assessed with regards to its

- completeness of the planned audits and activities,
- sequence of scheduled assessment and activities and
- coverage of the load cases or of the expected event spectrum on which the planning is based.

3. Best practices & cases

TÜViT - Quality Assurance during the commissioning

Assessment of commissioning-instructions and procedures

Commissioning instructions and procedures will be evaluated to ensure that:

- with the described procedures the intended availability class/level is achievable and
- the procedures described address the load cases and events on which the planning of the data center or the data center infrastructure is based.

Assessment of the implementation of commissioning activities and tests

This includes checking whether the commissioning activities and tests are carried out in accordance with the procedure laid down in the commissioning instructions and procedures.

Assessments of test results and anomalies

The results obtained in the course of commissioning tests and activities are evaluated in terms of the intended availability class/level. Among other things, acceptable tolerances are evaluated in terms of the intended availability class/level and further measures are initiated if necessary.

3. Best practices & cases

TÜViT - Quality Assurance during the commissioning

Assessment of the documentation

The documentation and protocols of the results obtained during the performance of the commissioning tests and activities shall be reviewed with regards to its:

- completeness and
- correctness.

Contract-Compliance and Secure Transition to the Operation

The following groups of persons and project participants may be involved in the planning, construction and operation of the data center; which usually involves contractual agreements or obligations (customer and contractor) between the different parties:

- customer (possibly also the future operator of the data center),
- designer,
- general contractor,
- subcontractor,
- suppliers and manufacturers,
- authorities and experts.

3. Best practices & cases

TÜViT - Quality Assurance during the commissioning

In general, the contracting party wishes to receive a good or service which the supplier provides in return for payment. In case of successfully completed commissioning activities or assessments payment obligations will rise or represent a transfer of responsibility and liability and mark the beginning of the warranty commencement.

Against this background, a third party participation in the context of quality assurance during commissioning offers the following advantages:

- Independent confirmation of the provision of a contractual service, e.g. the function of individual components or the availability of the supplying data center infrastructure, and therefore provides
    - performance assurance for both contracting parties and
    - avoidance of legal disputes.

- Avoidance of anomalies or conditions in a certification audit, since obstacles that stand in the way of certification can be identified and remedied early on. Many anomalies in a certification audit are ultimately a result of failures during the commissioning of a data center.

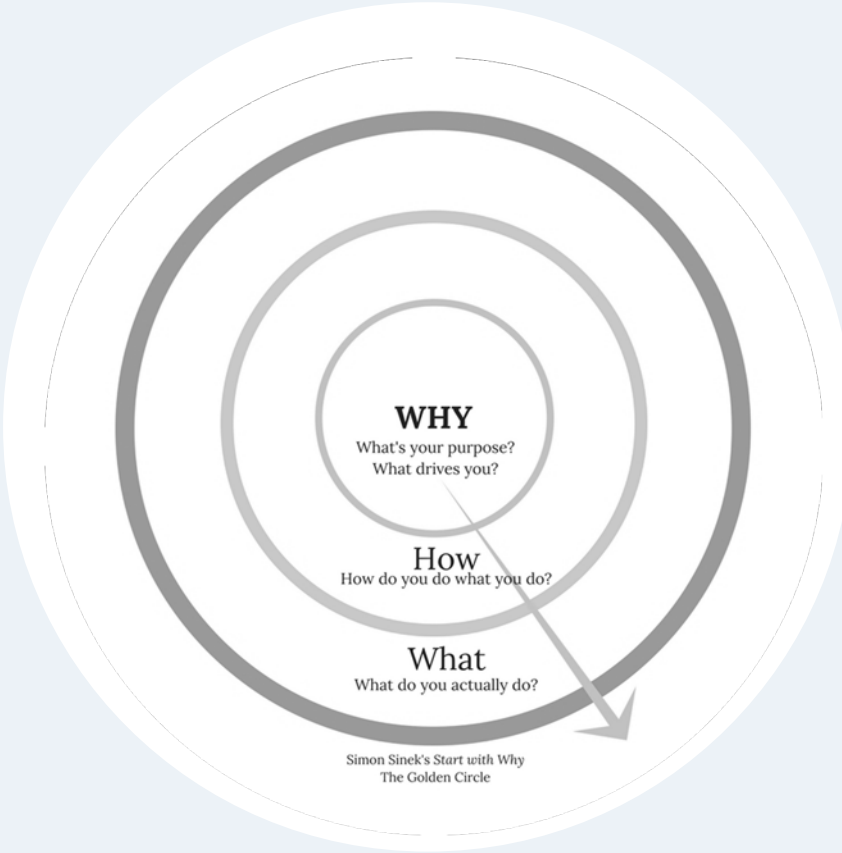
- Optimized data center operation through tested operating instructions and emergency procedures as well as enabling maintenance on the actual state of the data center, which can result in cost savings.

3. Best practices & cases

Zentrys – Keep commissioning simple

The design and construction process is only a limited period in the entire lifecycle of a datacenter. In most projects we see the pressure cooker is on during this process and commissioning is seen as a bottle neck towards hand-over to operations. The commissioning process is however one of the most critical processes as it will be difficult, not to say impossible to repair a number of punches during the commissioning.

What we learned and would like to share are the following basic principles:



1: Why: Start with why we do commissioning

What is the goal of the commissioning? This should translate in how and what we are commioning. The reasons may vary (multiple answers possible):

- Proof of evidence
- Guarantee
- Agreement
- Liability
- Hand-over
- Stress test / punches
- Certifications
- (Inter-)National regulations
- Local regulations
- Training operational staff

3. Best practices & cases

Zentrys – Keep commissioning simple

2. How: create the concept commissioning plan

Now we have agreed the goal of the commissioning in the commissioning plan should be further defined:

- What are the specs
- Where do we plan to commission (factory, on site, etc)
- What are the perimeters to check
- What are the deliverables
- Who is involved and responsible
- When are we successful

Ideally you would like to test the entire site in your level 5 commissioning, but don't forget the other perimeters like the grid connection, availability of power, availability of water and other environmental and financial thresholds that may impact the commissioning phases. This might be the reason to create commissioning .

Example:

- 60 MW IT distributed redundant site commissioning
- Commissioning of the entire site would mean a 90 MW peak (including facilities)
- Effect on the utility costs is roughly 5 million EUR (*calculated over a year)
- Decission: Commission in blocks of 5 MW, so that peak will not exceed 7 MW and save 90%

3. Best practices & cases

Zentrys – Keep commissioning simple

3. What: What we do in the several levels

This questions contains the action plan in the different levels resulting in scenarios. Based on the master commissioning plan wherein we have agreed budget, risk, time and minimum requirements are described we carefully plan the different actions or scenarios.

The question that should be answered during the entire commissioning process is often forgotten:

When are we successfull in achieving our goal?

3. Best practices & cases

Deerns - Summary T&C process

This Commissioning Plan of Record (CxPoR) provides a structure for the commissioning process (Cx process). Cx is a quality process which ensures, with documented confirmation, the proper installation and functioning of the building services as designed and specified. Cx ensures the Data Centre facility (DC) meets MS's project requirements, tender documentation and operational needs.

- Cx PM, main contractor.
- Cx A, Cx Agent.

Cx LEVELS

The Cx process comprises of 5 levels:

Level 0 : Review design
Level 1 : Factory Testing (FAT)
Level 2 : QA/QC Installation and civil inspections
Level 3 : Start-up witness testing
Level 4 : Site Acceptance Test (SAT)
Level 5 : Integrated Systems Testing (IST)

During every Cx level checks are performed to ensure that the building services are designed, installed and operate in compliance with the design intent. This process is not to diminish the responsibility of the contractor nor is it intended to be a redundant testing or inspection function. Cx is performed to document, validate and ensuring that the quality of the systems meet MS's project requirements as documented by the Detailed Design.

The transition from a lower to a higher Cx level can only be effected if all supplied quality and functionality meet the requirements for that transition.

3. Best practices & cases

Deerns - Summary T&C process

Cx PLAN

Deerns(CxA) has developed an initial Cx plan that is based on this CxPoR and adapted for the specific parameters of the DC project. The plan describes the extend of the Cx process to accomplish the project requirements and meet the basis of design. The Cx plan is a living document and can be updated throughout the project if needed. It will be updated with regards to:

- Systems and assemblies to be verified and tested
- Roles and Responsibilities
- Commissioning schedule
- Project specific communication protocols
- Project Organization Chart

EQUIPMENT TAGGING

A colour coded equipment tagging system which corresponds with the current Cx status of the tagged equipment shall be implemented. This provides a progressive visual indication at the equipment location stating at which level of Cx verification was successfully completed.

The CxPM is responsible for managing and implementing the tagging process and ensuring the equipment is signed off. The main contractor provides the tags and is responsible for informing the CxPM on the Cx progress.

Following tagging stages shall be implemented

- Not ready for start-up (Red Tag)
- Ready for start-up (Yellow Tag)
- Ready for Level 4 Functional Testing (Green Tag)
- Ready for Level 5 IST (Blue Tag)

3. Best practices & cases

Deerns - Summary T&C process

Cx PUNCH, SNAG AND ISSUES LIST

The CxA shall provide in visual reporting tools for managing Punch, Snag and Issues lists. Complete details in the comments section shall be listed accompanied with pictures and / or drawing fragments.

Issues shall be assigned to the responsible party. Once the issue is corrected the responsible party shall update the Cx punch list with the description of the repair and supply photos as necessary to show the issue was corrected.

The final Punch list shall include all issues currently and the items will be captured during the final Punch list walk.

3. Commissioning checklist

What to do in the different commissioning phases

1. PRE-DESIGN PHASE

- Assemble the commissioning team
- Involve key stakeholders in the commissioning planning process
- Create the Owner's Project Requirements (OPR) document
- Determine the initial commissioning scope, schedule, and budget
- Define the commissioning plan
- Implement contingency plans for special circumstances
- Decide how to leverage load bank technology into the data center commissioning
- Focus on selecting innovative load testing services that improve set-up time, safety, and operational efficiency
- Implement a load bank testing strategy into the commissioning plan that simulates electrical and thermal load characteristics of the equipment used in the data center
- Integrate power quality monitors to complete load tests in less time, collect more data, reduce reporting time, and consolidate devices
- Integrate all load bank functions, controls, and operations so the load banks can be operated remotely from the solution provider's network operations center

One word: Research! Take time to do the proper research to ensure you build a competent team. Once you have found the right general contractor, design team, commissioning agent and vendors, the likelihood of success has already increased exponentially. The budget should cover all items and personnel needed to support the commissioning. Scheduling should be timely and covers all commissioning activities to avoid any delays. Allow room for flexibility.

3. Commissioning checklist

What to do in the different commissioning phases

2. DESIGN PHASE

- Communicate the data center commissioning requirements to project team members
- Verify design documentation consistency with the OPR
- Include commissioning requirements in the construction documents
- Build engagement and cooperation among project team members

This is the phase where all plans, checklists, and reports are reviewed by your team. Ensure that the commissioning agent is involved in the design reviews. This should be done at the initial stages. This facilitates effective communication, as the commissioning agent gains an understanding of how the system works and your intention for the design of the system. The commissioning agent may then offer beneficial insights.

3. Commissioning checklist

What to do in the different commissioning phases

3. CONSTRUCTION PHASE I

- Update the data center commissioning plan as required
- Ensure commissioning team members understand roles and responsibilities
- Install equipment, systems, and assemblies correctly

Check all pieces of equipment that arrive on site, is it the correct quantity? Are there any scratches or dents? Any deficiencies? Best to know as soon as possible! Keep track of all reported deficiencies and deal with them accordingly. Do not allow any deficiency to slip through the cracks as that is detrimental to successful commissioning.

Start connecting the equipment. Check whether the valves and switches are functioning. Of course, it is best the check the connection of equipment together with the supplier, so no mistakes can occur upon setting-up the equipment.

The staff operating within the data center must understand the "ins" and "outs" of their facility. There's no better way to do this than during the Integrated and Functional System Testing. This is where they will get the opportunity to test the system's capacity (i.e. controls schemes, automatic and/or manual transfers, etc).

3. Commissioning checklist

What to do in the different commissioning phases

3. CONSTRUCTION PHASE II

- Confirm functionality and maintainability
- Provide the operations and maintenance personnel with complete systems operating documentation
- Create training documentation
- Train applicable personnel thoroughly
- Develop a plan for ongoing training

The Functional Commissioning scripts should be completed and reviewed by the team. Get feedback from the team before "challenging" the system. Review progress and activities in a daily meeting. One should encourage operations staff to be creative. Again, keep track of all deficiencies.

This is where you determine whether your machine is properly calibrated or needs tweaking. Validate all information that is received from the systems, like values, alarms, and notifications. Involve the operations team to ensure that they learn how the system operates and how to manoeuvre it.

Lastly, ensure all documentation is provided upon completion. Operators can effectively run the data center once all documents, namely the final commissioning and as-built documentation, are accounted for.

3. Commissioning checklist

What to do in the different commissioning phases

4. OCCUPANCY AND OPERATIONS PHASE

- Complete any functional testing and training not completed during the construction phase
- Finalize systems and commissioning documentation
- Confirm a successful turnover to operations and maintenance personnel
- Evaluate and optimize facility performance
- Implement a plan for ongoing commissioning of the data center over time
- Evaluate the project and measure the level of success

3. Commissioning checklist

What to do in the different commissioning phases

5. ONGOING MAINTENANCE

- Update the maintenance plan as required
- Use load banks to perform load testing on a regular basis to:
    - Ensure subsystems in the data center operate as intended
    - Reduce equipment and process failures
    - Identify issues and corrective actions required
    - Increase component life cycle
    - Create energy savings
    - Improve data center reliability and availability
    - Enhance cost efficiencies for equipment-related tasks

4. APPENDICES

4. Appendices

Further reading

WHITE PAPER RENTALOAD – JUNE 2019

Load banks and Data Centre Commissioning Tips, Field Notes & Best Practices.
https://rentaload.com/wp-content/uploads/2019/03/Rentaload-White-Paper-March-2019.pdf

WHITE PAPER VERTIV– 2017

Commissioning your data center for greater availability, safety and efficiency while reducing costs throughout the lifecycle:
https://www.vertiv.com/globalassets/services/services/project-services/commissioning-your-data-center-for-greater-availability-safety.pdf

4. About

About Rentaload

Rentaload is a Load bank services company, based in France with offices in the UK and Germany, covering projects across the whole of Europe. Rentaload leverages its partners many years of experience in manufacturing load banks and as a result, offers its clients rental and services solutions for resistive, inductive and capacitive load banks, built and optimized specifically for datacentres. Rentaload provide banks, accessories, and services such as set-up de-mobilization, assistance in commissioning, commissioning for multiple applications all over Europe: testing diesel generators, acceptance testing for server rooms, dummy load, unloading, etc.

Contact information

Rentaload UK
18 Lumen Road,
East Lane Business Park HA9 7RE Wembley,
London, UK

Rentaload FR
1, chemin de chaumour 21500
Montbard, FRANCE

contact@rentaload.com
www.rentaload.com

4. About

About Vertiv

With a history of industry-changing solutions and a well-earned reputation for innovation, Vertiv and its partners continue to raise the bar in the areas of power, cooling, access and control, monitoring, and manageability.

We offer the expertise you need, the reliability you demand, and the resources only a global partner can provide. We trace our roots back to the beginning of the information age, but our organization began to take shape in 2000 when Emerson brought its critical infrastructure technologies together under the Network Power umbrella. By 2016 the solutions provided by Emerson Network Power, as well as the people that stand behind them, were strong enough to stand alone as Vertiv.

To learn more about Vertiv's services and certifications in the data center sector visit:
https://www.vertiv.com/

4. About

About Deerns

Consulting engineers over 90 years

We need ideas with vision. Ideas that meet our rapidly changing world, the growing standard of global prosperity and the increasing need for people to have a healthy, safe and comfortable living environment. Ideas that also take into account stringent hygiene and safety regulations and that address the concerns of climate change and CO2 emissions.

As an independent engineering firm with 500 specialists worldwide, Deerns has the skills to make those ideas a reality. Indeed, as experts in the field of technical infrastructure for buildings and facilities in urban and industrial areas, Deerns has been doing this since 1928, tailoring its approach to every client's unique needs and specifications. From concept to design to supervision to aftercare: Deerns brings concepts to life.

To learn more about Deerns services and certifications in the data center sector visit:
https://www.deerns.com/

4. About

About Unica Data Centers

Unica Datacenters is the number one Data Center Specialist based in the Netherlands that realizes intelligent, technologically advanced Data Centers in Europe.

For more than 20 years Unica Datacenters has been engineering, constructing, commissioning, configuring, maintaining and optimizing Data Centers. We also implement white space and infrastructure and facilitate secure storage of data. That is how we contribute to a better and still growing digital world.

Large or small, simple or complex. We support our clients, as General Contractor, with all their Data Center solution challenges, from A to Z, and ensure them that their Data Center satisfies their needs in years to come. Whether it is a greenfield turnkey project constructing a Data Center for colocation, designing & engineering modifications for a telecom company or expanding computer rooms within enterprises, Unica Datacenters is your Data Center Specialist.

To learn more about Unica Data Center services and certifications in the data center sector visit:
https://www.unica.nl/datacenters-en

4. About

About TUViT

TÜV Informationstechnik GmbH (TÜViT) is a worldwide-recognized evaluation and certification service-provider for data centers, colocation- and cloud-infrastructures, with more than 500 data center certifications issued globally since 2002.

With vast experience TÜViT is an unbiased and competent partner in the assessment and certification of data centers in terms of their availability aspects and energy efficiency in context of the EN 50600/ ISO 22237 , the TSI.STANDARD (Trusted Site Infrastructure) and ISO 50001. TÜViT provides neutral assessments and supports in every important phase of the data center life cycle, such as concept, design, construction, commissioning and operation.

Its portfolio also includes topics like cyber security, software and hardware evaluation, IoT/Industry 4.0, data protection, ISMS, Smart Energy, mobile security, automotive security, eID and identity verification services. TÜViT founded in 1995 and headquartered in Essen, Germany, is a member of the TÜV NORD GROUP, one of the world's largest technology service providers with over 10,000 employees and business activities in 70 countries worldwide.

To learn more about TÜViT's services and certifications in the data center sector visit:
https://www.tuvit.de/en/services/data-centers-colocation-cloud-infrastructures/

4. About

About Zentrys

Zentrys is a 100% datacenter services company active throughout the lifecycle of datacenters and active in Europe with offices in the Netherlands, Ireland and Germany. The main pilars in our services are Consulting, (Re-)Design+Development and Operations.

Over 40 Zentrys professionals count over 200 years of expertise datacenters and are responsible for over 100 MW. Datacenters are built in months to last decades. The mix of standardised in-house operational excellence, engineering and development knowhow create excellent results of our projects. The kind of projects vary from end-to-end design and development till independant third-party services like compliancy and commissioning wherein we always focus on long term relations with our customers.

Zentrys and it's sister company Elektrys have reviewed, created and managed multiple commissioning plans for it's customers varying from hyperscalers till colocation-parties. Herein a professional, pragmatic, reliable and less time consuming approach has provided excellent results.

To learn more about Zentrys and certifications in the data center sector visit:
https://www.zentrys.com

4. About

About Dutch Data Center Association

The Dutch Data Center Association (DDA) is the trade associations of data centers in the Netherlands, the bedrock of the Dutch economy. The DDA unites leading data centers in the Netherlands in a common mission: the strengthening of economic growth and the profiling of the data center sector to government, media and society.

The DDA expresses industry views on regulatory and policy issues. It demonstrates leadership by facilitating and encouraging members to implement operational improvements in the form of best practices.The DDA promotes education and contributes to technical standards, which enables the data center industry in the Netherlands and abroad to further distinguish itself.

The DDA closely collaborates with Digital Gateway to Europe, which promotes the Netherlands as international data hub.The DDA also actively collaborates with market operators, the government and other interested parties.

Contact information
Dutch Data Center Association
Anthony Fokkerweg 61
1059 CP Amsterdam
The Netherlands
+31 20 3037860
info@dutchdatacenters.nl
www.dutchdatacenters.nl

4. Colophon

The Dutch Data Center Commission Guide is an study initiated by the Dutch Data Center Association, Rentaload, Deerns, Vertiv, Unica Datacenters and TÜViT.

Edition
Dutch Data Center Commission Guide
January 2020

Contributions
DDA
Rentaload
Deerns
Unica
TÜVIT
Vertiv

Editor-in-Chief
Stijn Grove

Marketing & artwork
Zoë Derksen

Print quantity

First release, April 2020: 100

Availability
Our publications are free to download on www.dutchdatacenters.nl

Our publications

Maart 2020

Jan 2020

Juni 2019

Maart 2019

Okt 2019

Download all the latest, most up to date industry information:
www.dutchdatacenters.nl/publicaties
www.digitalgateway.eu

DUTCH
DATA CENTER
ASSOCIATION

— 2020