



The end-to-end reliability forum.

A Roadmap to Developing the Mission Critical Operator Program in Your State

This document was written and prepared by Robin Aron of the Carolinas Chapter, and a member of the Chapter Relations Committee of 7x24 Exchange International. This document is based on my experiences with then Chapter and specifically, Paul Marcoux, in creating the MCO curriculum and program in North Carolina. It is an outgrowth of a request made by several Chapter Leaders during the Chapters call of September 24, 2015, and intended to provide guidance and direction to those Chapters interested in pursuing MCO Programs in their states and/or regions.

1. Create an Education Committee of the Chapter
 - a. Choose an end user to chair this committee. (someone with a Purpose and desire for educational initiatives)
 - b. Obtain 3 members of the committee (make sure one functions administratively with responsibility for meeting scheduling and coordination, documentation circulation, action item development, etc.)
 - c. Create a stated Mission for the committee. Carolina's is as follows:
 - i. *The 7x24 Exchange Carolina's Chapter Education Committee will work to support the knowledge transference of the 7x24's Mission Critical Operational groups knowledge base into our State sponsored technical college system for the development of a formal MCO training program. We will also work with graduates to provide internship ship and mentoring opportunities in operational data centers or other mission critical facilities. Our ongoing vision is to promote equal opportunity assistance by bridging the gap between IT and mission critical operations by delivering a workforce completely trained in IT and mission critical operations practices. Lastly, we will provide our open support to any 7x24 Exchange chapter by offering our guidance and experiences in this endeavor. r-*
 - d. Create a separate bank account for the Education Committee and establish a beginning balance. This is used to -, support educational initiatives.



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- e. Create a revenue stream for funding the Education Committee. Carolina's is our annual Golf Tournament. Name: Bob Cashner Memorial Golf Tournament, after one of our members/end users who passed.
2. Establish specific goals and objectives for the first year.
 - a. Communication with area community college's to determine offerings and students eligible for scholarship funding. (Carolina's Chapter gave 3, \$1,200.00 scholarships in year one.)
 - b. Create specific scholarship initiative statement (See Carolina's below) and distribute to the board and membership.
 - c. Create criteria for scholarships (See Carolina's below)

Giving the scholarships was the door opener for the Carolina's Chapter to the Community College System. They perceived our sincere interest in education! For long term support we discovered that Scholarships served to few and drained resources to quickly, hence the need to support State sponsored technical school system,

- d. Develop relationship with the Community College system at the State level. Carolina's relationship was with the VP of Customized Training of NC Community College System and President of the NC Community College System. This was developed through one of our Advisors we had serving on the Board from State Economic Development. (I highly recommend every Chapter has an advisor from their state or at least a local economic development office.)
 - e. Highlight the Education Committee at one of the Chapter events. (See presentation slides below).
3. Circulate and become familiar with the MCO Curriculum (Document below)
 - a. Send to colleges that you vetted for scholarship funding.
 - b. Circulate to end users for interest and support that will bring leverage when talking with colleges about adoption of the curriculum. NEED and VALUE must be noted. (see letter of support in slide deck. Many end users reached out directly to support)
 4. Define the areas of largest concentration and data center growth in the State.
 - a. Recruit end user involvement in these regions.
 - b. Become familiar with DC growth projections for the area.



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- c. Understand the multi-industry utilizing MCO's - Enterprise DC, Colo, Financial, Healthcare, Pharma, Retail, etc. It was vital to make the Community College system understand that the job creation was not just in the primary enterprise DC's they were familiar with. It must be articulated to include ALL the needs and opportunities for MCO's.
5. Engage Subject Matter Experts for use in meetings with Colleges.
 - a. People to consider....DC Operations Managers, those companies that provide 3rd party operations for critical facilities, engineers.
 - b. Have the SME's take the Certification testing available from NCMCO.
 - c. Schedule conference call or visit to fully understand the NCMCO with Jonathon Davis (Cleveland Community College).
 - d. Set meetings with Community College representatives.
 - e. Engage Jonathon with connections



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7x24 Exchange Carolinas Chapter - Scholarship Initiative:

General: The purpose of this initiative is to extend the 7x24 groups knowledge base into the technical college and general college curriculums to provide better, well rounded graduates that have current information on IT and Facilities Best Practices and energy strategies to make them more valuable to our members once they become available to the workforce. One way to do this is to become partners with the colleges and universities in the Carolinas in making sure that deserving students can be funded through their education. These scholarships should be awarded on merit and should be selected by the individual learning institutions.

By promoting the Carolinas 7x24 through the faculty and staff, we maybe can enjoy success similar to ASHRAE; where by local members are selected to provide a class in their particular field of Mission Critical either as an end user, engineer, constructor, vendor rep or consultant to give real world application to the curriculum.

To fund these scholarships, we will need to consider the yearly amounts budgeted for this program in our operational and fund raising efforts. These could possibly come from membership dues, special event proceeds (like the golf tournament) and other yet to be determined efforts for funding.

If this initiative passes, the next steps might include:

- The formation of a Scholarship Committee, which could possibly be a subcommittee of Membership.
- Determine first year funding for this program.
- Have the Scholarship Committee create the program specifics.
- Vote on funding and program by the Board.
- Implement the program.

Summary: Better trained graduates in IT and Mission Critical Facilities benefits all members by promoting the Carolinas as successful area for Data Center Operations and development



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July 12, 2011

Organization: 7x24 Exchange The Carolinas Chapter: [7x24 Exchange The Carolinas Chapter](#)

Committee: 7x24 Exchange Carolinas Chapter, Scholarship Award Committee

Proposal: A proposal to initiate an annual Scholarship Award sponsored by the 7x24 Exchange Carolinas Chapter.

Institutions: One in Eastern NC, one in Western NC and one in South Carolina.

Funding: First year, one award per institution at \$1,200 each; Second year, two awards at \$1,200 each per institution and possibly intern support.

Focus: It is proposed the Scholarship Award committee will focus on Accredited Community Colleges or Technical Training Schools within North and South Carolina.

Note: this does not include "for profit" school systems.

Institution Validation: To validate that an institution qualifies, a short 10 question questionnaire will be completed by the perspective institution.

Proposed Qualification Questions:

1. Is your institution accredited and if so by whom?
2. Would your institution be willing to develop the selection criteria and select the candidate(s)?
3. Does your institution support technical education in the electrical and mechanical fields?
4. Does your institution have an understanding of what Mission Critical Services is?



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5. Does your institution have other scholarship programs and if so what types?
6. Does your institution support intern programs and if so what are the top five employers?
7. Does your institution provide IT training?
8. Does your institution have a career placement office?
9. What is the total number of active students enrolled at your institution?
10. What is your expectation of scholarship support level, financial and otherwise?



7 X 24 Exchange The Carolinas Chapter

Education Committee: 2012 Report

By: Paul A. Marcoux, Chairman Education Committee
January 2013



2012 Notable Accomplishments

- Raised MCO Training Awareness
 - State Education Level
 - 7x24 National
- Assisted in the development National Science Foundation Grant (\$600,000) for MCO training
 - Cleveland College, Isgothermal Community College, Catawba Valley Community College, Caldwell Community College and Technical Institution
 - Grant has been finalized and submitted to the National Science Foundation, notice to be made in August
- Continue building relationship with Dr. Ralls, President of NC Technical Schools
- Renamed Education Grant "Bob Cashner Memorial Scholarship Fund"
- 2012 MCO Survey Mission Critical Operators want trained MC Operations people
- Added New Committee Members
 - Mr. Jason A. Green, VP, Strategic Development Sentinel Data Centers
 - Mr. Masoud Pourali, PhD, PE Kimia Power
- Held Face to Face Education Committee Meeting, September 20, 2012
Attendees:
 - Margie Bukowski
 - Paul Marcoux
 - Jason Green
 - Masoud Pourali



NSF Grant Support Letter



October 3, 2012

Dr. J. David Herring, President
National Science Foundation
477 Lusk Drive
Washington, DC 20541

Dear Dr. Herring:

The 7x24 Exchange International is pleased to have your letter regarding our proposed grant application for the National Science Foundation. We are excited about the opportunity to receive your support and to be part of a program that will help us advance our mission of providing training and education to the next generation of Mission Critical Operators. We are grateful for your interest in our organization and for your support of our efforts to provide training and education to the next generation of Mission Critical Operators. We are excited about the opportunity to receive your support and to be part of a program that will help us advance our mission of providing training and education to the next generation of Mission Critical Operators. We are grateful for your interest in our organization and for your support of our efforts to provide training and education to the next generation of Mission Critical Operators.

Paul A. Marcoux, 7x24 Exchange International Board Member and Chairman Education Committee

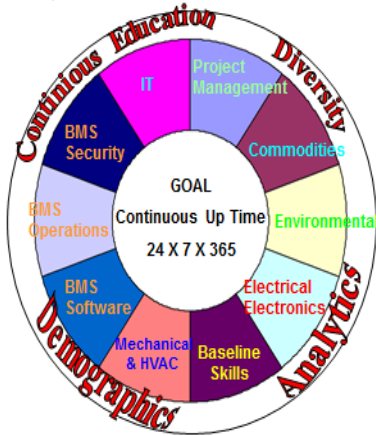
Paul A. Marcoux
7x24 Exchange International Board Member and Chairman Education Committee





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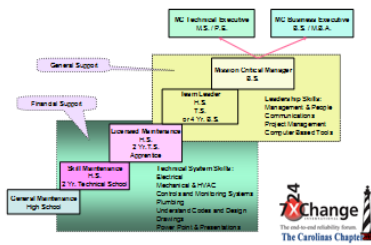
Mission Critical Organization
Diverse Skill Requirements



What are we doing about it
Seeding at the Technical System Level



Mission Critical Career Ladder



Addition on IT Component



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Mission Critical Operators Training Curriculum

January 6, 2012

This curriculum outline focuses on Mission Critical Data Centers, yet Mission Critical Operations (MCO) is not just for Data Centers. You can find MCO applications in many other industries such as hospitals, utilities, 911 Call Centers, critical process manufacturing and telecommunications facilities

General:

Your education will not stop at your graduation, it only begins. The MCO graduate will work side by side with the Information Technology (IT) individuals. In your challenging MCO role you will gain a critical understanding of IT's processes, procedures and Data Center equipment operations that you will support.

A career in mission critical operations is rewarding both professionally and personally. MCOs represent an employment position that is an advanced position above regular installation, service and repair technicians. MCO technicians demonstrate a desire to move beyond the basics and view a facility as a whole and can navigate within the facility conducting tasks in a very integrated manner.

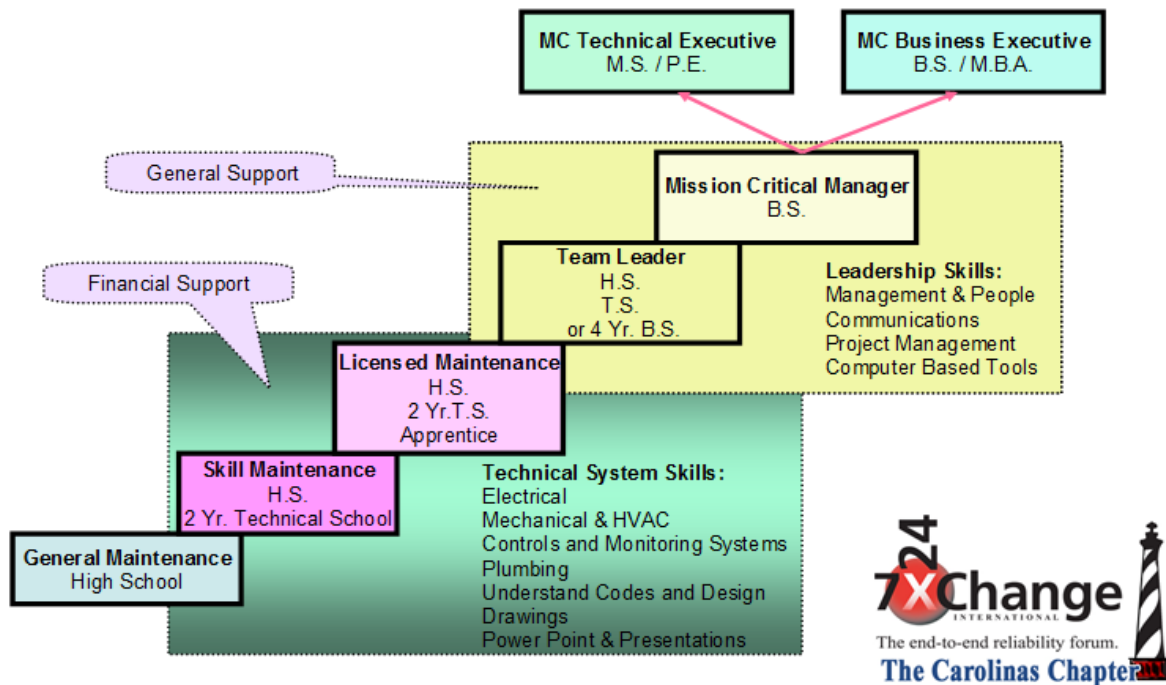
Core Knowledge Curriculum: A standard curriculum of building technology is a basis for a successful facility operator in a mission critical environment. Competency in HVAC including Digital Control Systems, Electrical, Plumbing and General Construction goes a long way in providing the basis of a respected datacenter operator. Here is a breakdown of the



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requirements for each with a brief dialogue of their importance in an Mission Critical Operator (MCO) candidate.

Mission Critical Career Ladder



7x24 Exchange, Financial Support:

For those individuals wishing to pursue a career as a Skilled Maintenance provider or becoming a Team Leader or progress into Mission Critical Management position.



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Suggest Curriculum Outline Mission Critical Facility Operator

1. **Heating Ventilation and Air Conditioning (HVAC):** Data centers use energy, the resultant heat has to be shed to support proper operations in the data center environment. Facility Service Areas require comfort cooling for personnel. Both must be maintained to promote reliable operations.
 - a. **Principles of Hydronic Flow:** Many data centers rely on water to cool either through evaporative cooling or a combination of mechanical cooling and evaporative cooling. A thorough knowledge of fluid dynamics is required.
 - b. **Principles of Mechanical Cooling and the Refrigeration Cycle:** Whether it be from water cooled Chillers, or from direct expansion (DX) units, understanding the physics, troubleshooting and repair of the components of the refrigeration system is essential to the successful MCO.
 - c. **Heat Transfer:** While similar to A and B above, understanding how servers release heat is important in understanding how best to cool them. Understanding technologies and the physics of heat flow technology from air to water is important in many mission critical operations.
 - d. **Air Flow Design and Operation:** Many data centers rely on hot aisle / cold aisle cooling or some element of air containment to cool their data center equipment. Understanding the technicalities of air flow and the principals that determine how air can effectively support heat transfer for servers. The Data Center has taken on many new shapes in this new century the MCO candidate should be familiar with the many different design and criteria that govern air flow in Data Centers. , Controls: Most Data Centers have sophisticated control systems that provide control and instantaneous messaging to operations in the event of a condition determined to be out of a normal state. An MCO will understand the control system elements, field devices and their usage, control system architecture and how mechanical and electrical devices communicate information back to operations, and how to design such communication to promote increased reliability.
 - e. **Best Practices in Current Data Center Cooling Design:** The MCO will need to understand the various data center cooling design strategies, the concepts that are presented in psychometric charts and how they apply to different types of Data Centers. This should include current temperature and humidity limits for both normal and utility operations as defined by The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).



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2. **Plumbing:** Many cooling strategies incorporate water as a cooling medium in some stage of the cooling process. In some operations, evaporative cooling plays a critical role in this cooling process. Without water, the process fails.
 - a. **Understanding the utility.** Most water consumed by a data center is provided by a water utility. Pressure is provided either by pumping or by gravity (water towers). Most data centers are designed using multiple water connections such if one connection is shut down for any reason, another separate and discrete connection can continue the supply. The successful MCO will understand the importance of the source of water and what events might trigger an impact to that source.
 - b. **Understanding different water piping designs.** Some data centers are designed with emergency storage water systems. The MCO needs to understand how these systems work, how to care for the water systems and how to support its longevity..
 - c. **Water Treatment.** Most cooling water requires treatment. Understanding various water treatment technologies will provide the MCO with tools to understanding the how and why of water treatment more thoroughly regardless of the method used.

3. **Electrical:** Electricity is the essential and common element in all data centers. How this electricity flows from the utility to the servers and support equipment is important to maintain a dependable data center environment.
 - a. **Understanding the utility:** Who is the utility and how does the power enter the facility are two key elements of data center operations.
 - b. **Electrical Knowledge:** How electricity is made, how does it flow and what is the architecture of the electrical installation in a typical data center environment. This would include typical distribution devices, switches and other components. Understanding how electricity gets from the grid to the rack is essential knowledge for a MCO.
 - c. **Safety:** Knowledge of safety requirements in the mission critical environment and in general electrical service, operation and repair. Knowledge of Arc Flash Safety and other National Fire Protection Association (NFPA) standards are essential.
 - d. **Emergency power:** Generator operation and general maintenance, UPS types and how they work, how they are tested and maintained.
 - e. **UPS Systems:** Batteries may represent an important part of the electrical distribution system. Data Centers are designed to maintain server functions throughout a wide range of environmental and infrastructure conditions. In some cases batteries are the bridge between power sources. The technology behind the electro-chemical process the battery uses as well as the methods used to determine battery health must be part of the MCO candidate's tool bag.

4. Life safety systems



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- a. **Fire Suppression systems:** The MCO candidate is not only responsible for the facility they are also stewards of the life safety systems within the facility. The Data Center life safety systems are designed to be highly reliable so that accidental suppression discharges are prevented. Detection systems are also specially designed to ensure advanced warnings to guard against mass destruction or activation for non-coincident conditions.
- b. **Hydrogen monitor/refrigerant monitoring** may also be present in a facility. These systems also provide early warnings to abnormal conditions and require unique response steps.

5. **General Construction:** Operators own the site from the equipment inside to the rocks outside of the building. A general knowledge of building technology and maintenance is required to understand any liabilities in facility design to steady state operations. For example, roof design over a data center is important to understand to protect servers beneath it. Membrane roofing systems require special protocols to be established to reduce the chance of puncture or breach.

The MCO should also understand the basics behind LEED and the USGBC.

6. **Computer Basics**

This course introduces students to the basics of computer hardware and architecture, system software, application software, common computer networking systems and the internet. Students come to understand the component design of a computer, recognize common types of computer system and application software, identify various types of common computer network systems and understand the theory behind the world's biggest computer network, commonly known as the Internet.

Students examine network concepts, standards, technologies, media, protocols, and topologies. Topics include connectivity, network devices, basic security, local and wide area networks, network design, transmission media, structured cabling, IP addressing and Open Systems Interface (OSI) model.

7. **Development and implementation of operating procedures in the mission critical environment.**

- a. Understanding the definition and form of:
 - i. Standard Operation Procedures (SOP)
 - ii. Emergency Operation Procedures (EOP)
 - iii. Maintenance Operation Protocol (MOP)
- b. Understanding the importance of the changes in the operation of the data center.
- c. Understand the need to continuous training and safety awareness.



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8. How to develop a “mission critical attitude”.

- a. How a mission critical environment different from other industry environments.
- b. How equipment is maintained or other service performed in a mission critical environment.
- c. Effective traits of a MCO.
- d. How to think as a MCO.

9. How to get a job in a mission critical environment.

- a. Who is hiring.
- b. What are the resources available to graduates?

10. A distinguishing success factor of an MCO individual is their ability to **communicate and project manage**. The MCO individual has direct responsibility for the heartbeat of a company and therefore may be called upon at any time to communicate with executive management or authorities having jurisdiction.

- a. MCO individual will have working knowledge in developing Power Point and Excel presentations.
- b. Have strong verbal communication skills.
- c. Have strong written communication skills.
- d. Because MCO is an adaptive organization, skills in project management are essential

7x24 Exchange, General Support:

For those wishing to peruse an Engineering career or are focused toward Mission Critical management as an objective:

**Suggested Curriculum Outline
Mission Critical Manager; Mission Critical Executive**

Math

Relations and functions are investigated graphically, numerically, symbolically, and verbally. Exponential, logarithmic, polynomial, power, and rational functions are explored. Special topics include systems of linear and non-linear equations. Applications are investigated from science and engineering perspectives. Technology is integrated throughout the course.

Literature & Writing



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Develop skills in analytical reading, critical thinking, and expository and persuasive writing.

Students compose several essays using a variety of strategies to present evidence in support of a thesis.

Organizational Behavior

Assessment of self, personality, self-concept, perception and verbal and nonverbal communication skills; including organizational behavior concepts and practices. Discussion of diversity, job success and development of effective work relations. A view of workplace dynamics including conflict resolution, assertiveness, team problem solving and decision making.

Electrical Theory

Present basics of electrical theory, develop an understanding of voltage, current flow, parts of a circuit, electronic components, basic electrical calculations, transformer theory, electrical safety and NFPA awareness.

Mechanical Theory

Present basics of fluid dynamics including fluid turbulence, pump design, heat transfer, valve design and performance characteristics, water chemistry, adhesion and cohesion properties of water and oils, refrigeration basics

Focused Education Courses:

Electrical Circuit Analysis

International System of Units, engineering notation and prefixes, definitions of current, voltage, resistance, power, work and efficiency. For DC circuits: Ohm's and Kirchoff's Laws, series, parallel, and series-parallel circuit principles, superposition, Thevenin and Norton theorems, mesh current and node voltage analysis. Capacitance, inductance, reactance, and impedance. Transient analysis of RL and RC circuits. AC circuit phasor analysis.

Mechanical Systems

Student will learn all aspects of the psychometric chart. Be able to perform complex heat flow calculations, understand the dynamics of air flow and the characteristic changes that occur with atmospheric changes as well as altitude changes. Be taught Thermo-dynamic principles and understand the concepts of adiabatic and polytrophic process.

Computer Basics



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This course introduces students to the basics of computer hardware and architecture, system software, application software, common computer networking systems and the internet.

Students come to understand the component design of a computer, recognize common types of computer system and application software, identify various types of common computer network systems and understand the theory behind the world's biggest computer network, commonly known as the Internet.

Students examine network concepts, standards, technologies, media, protocols, and topologies. Topics include connectivity, network devices, basic security, local and wide area networks, network design, transmission media, structured cabling, IP addressing and Open Systems Interface (OSI) model.

Business Communication

Student will learn the forms of business communication, verbal and non-verbal communications and the challenging need for excellence in communication. The newest forms of sending messages - e-mail, the Internet, fax, long distance - as well as more common forms of communicating messages from point A to point B, such as the typewritten word and the US mail system - are covered.

The course covers writing letters, proposals, resumes, application letters, memos, intercultural messages and more. Communicating good news as well as bad news is covered. The fundamentals of proper business writing, usage of grammar, format, style and layout of business documents are presented. The student will be graded on how well he/she uses correct grammar to solve today's multi-faceted business problems using modern forms of communication.

Project Management

Introduce students to the principles and application of project management techniques with an emphasis on the design and management of computer information systems projects. Topics include project planning, work team design, project estimation techniques, project reporting, identifying and controlling project risks, budgets, and quality assurance.

In closing, there are many good resources for teaching literature to support this curriculum. In addition to these resources, 7x24 of the Carolinas has pledged to help seek out and support guest speakers from within the industry, many being potential employers of graduates.