Opportunities for Professional Upgrading of Quality and Reliability Personnel in the Cape Kennedy Area

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THE BENDIX CORPORATION
LAUNCH SUPPORT DIVISION

SUMMARY

Continuous professional growth of each individual becomes mandatory in order to meet the challenge of 1970. This continuous individual growth in most professions is being made possible through such activities as seminars, conventions, space congresses, but even more so by courses offered through universities and colleges.

Recent activities of The American Society for Quality Control, Education and Training Institute are providing some opportunities for professional upgrading. The most recent of these activities is the professional certificate program in Quality Engineering. In addition to this program, there exists extensive interest and participation in specialized training institutes, conventions and seminars throughout all areas of the ASQC.

Before real professional growth can occur, there must be a corresponding growth in areas of higher education. According to a survey completed by Catherine Hock and presented to the 1966 convention on maintainability and reliability, there exists an extremely limited availability of quality and reliability higher education opportunities within the United States. There are only two (2) colleges offering associate degrees in quality and reliability; San Diego City College and Brevard Junior College. There is no degree program at the Bachelor of Science level. Only one (1) college or university offers a Master's Degree with a reliability or quality option, namely Florida Institute of Technology, Melbourne, Florida.

This brief summary of the "state of the art" illustrates the dire need for concerted effort by all involved in quality and reliability to work toward established higher education opportunities to meet the challenge of 1970.

INDUSTRIAL TRAINING PRACTICES

Within the KSC/CKAFS Complexes there exists over eighty (80) industrial firms each with Quality and Reliability training activities ranging from on-the-job training to formal classroom training. A survey of some of the major aerospace firm's educational activities illustrates this situation:

1. Each of the companies surveyed conducted training in special processes/operator certification such as:
   a. Reliable solder connections - 24 - 40 hours
   b. Potting and molding - 8 - 24 hours
   c. Contamination control concepts and techniques (usually a series of courses ranging from several hours to 24 hours each)
   d. Welding - no formal courses with exception through Technical/Vocation Schools.
   e. Other special process training as required by product and services.
2. Each of the companies surveyed conducted basic Quality and Reliability courses, however, these are limited primarily to training in Quality and Reliability Policy, Procedures and Data Systems.

Since the initiation of this program a continuous interest and growth has occurred. As in any new program, the first two years determine whether it becomes a vital program or will settle at a mediocre level. The following chart illustrates the significant growth factors:

	Jan 65	Aug 65	Jan 66	Aug 66	Jan 67	Total
QCR 201 Quality Control Concepts and Techniques	26	21	19	26	30	122
QCR 202 Inspection Principles and Techniques	—	17	—	—	32	49
QCR 203 Quality Control Engineer	—	—	22	12	—	34
QCR 206 Introduction to Non-Destructive Testing	—	—	15	—	22	37
QCR 207 Value Engineering	—	—	—	14	—	14
QCR 208 Contamination Control	—	—	—	13	18	31
QCR 211 Reliability Objectives	—	—	—	—	—	—
QCR 212 Quality Control and Reliability Management	—	22	—	—	8	30
Totals	26	60	56	65	110	317

This awareness of need for professional growth opportunities in this area was not limited to QCR. This awareness culminated in the founding of Brevard Engineering College, later renamed Florida Institute of Technology.

FLORIDA INSTITUTE OF TECHNOLOGY

Early in the history of Cape Canaveral (later Cape Kennedy) missile activities, it became apparent to some of the Engineers and Scientists that higher educational opportunities were non-existent. They banded together with the aerospace industry to form Brevard Engineering College. Their activities were primarily limited in the beginning to an evening school conducted by these same engineers and scientists. They established Bachelor Degree programs in Physics, Mathematics, Electrical Engineering and a totally new degree in Space Technology and Operations Research. More recently they have added the Bachelor of Science in Computer Sciences and the PhD program in Space Technology.

It is the Master of Science Degree in Mathematics (Reliability Option) with which we are concerned. The Reliability Option grew out of a need that was felt by both the College and the Aerospace Industry. Although this degree program concentrates on the mathematical aspects of reliability, it goes the second mile to include related subjects. The following curricula illustrates:

MASTER OF SCIENCE DEGREE IN MATHEMATICS
(Reliability Option)
Florida Institute of Technology
C. RELIABILITY OPTION

M-505	Advanced Calculus	3 hrs.
M-535	Theory of Determinants & Matrices	3 hrs.
M-545	Mathematical Statistics	3 hrs.
M-546	Mathematical Statistics II	3 hrs.
M-548	Reliability Theory & Application	3 hrs.
M-549	Systems Reliability Problems	3 hrs.
M-551	Experimental Design	3 hrs.
M-592	Special Problems in Reliability	3 hrs.
M-605	Thesis	3 hrs.
M-607	Thesis	3 hrs.
OR-523	Mathematical Programming	3 hrs.
ST-560	Dynamics of Elestic Systems	3 hrs.

In the case of each option, the remaining courses may be selected from those offered in the graduate mathematics department and other graduate departments, as approved, including the courses listed below. The course must be selected so as to form a unified program bearing on the field of study selected by the student.

EE-531	Random Processes
EE-532	Communication Theory
EE-545	Logical Design of Digital Computers
EE-546	Logical Design of Digital Computers II
OR-521	Inventory Theory
OR-522	Queueing Theory
OR-523	Mathematical Programming
OR-524	Decision Theory
OR-531	Statistical Decision Theory
P-515	Analytical Mechanics
P-516	Wave Equations
P-517	Classical Electromagnetic Theory
P-518	Classical Electromagnetic Theory II
ST-540	Astrodynamics
ST-541	Astrodynamics II

A comprehensive written examination must be passed covering the general field of mathematics and including all courses taken. An oral examination in defense of the thesis is also required.

BACHELOR OF SCIENCE DEGREE IN QUALITY ENGINEERING

The same basic barometers which forecast the need for the degree program outlined above, are now indicating an urgent need for an additional educational program. The most significant indication includes (a) the prevailing shortage of engineering personnel within Reliability and Quality organizations; (b) the current efforts by The American Society for Quality Control Education Institute for professional certification; and (c) the sudden increase in seminars, training institutes and conventions devoted to quality and reliability.

Added impetus is provided by the number of students attending evening divisions of Brevard Junior College and Florida Institute of Technology within the KSC/CKAFS area.

As a result of this type of industrial training, personnel become thoroughly indoctrinated in company policy and systems without any real understanding of the Quality or Reliability principles involved. This inhibits professional growth as it is not transferrable when an employee changes companies or when management changes policy.

To compensate for this form of training, it is necessary to provide higher educational opportunities which deal directly with the principles and techniques involved. An example of non-company oriented program dealing with such aspects of Quality and Reliability is the Associate Degree in Quality Control and Reliability conducted by Brevard Junior College.

ASSOCIATE DEGREE IN QUALITY CONTROL AND RELIABILITY

As an awareness of the inadequate industrial training and the need for professional upgrading within quality and reliability appeared within the aerospace industry, action was taken through a joint venture of Brevard Junior College and the Canaveral Section of ASQC. This action resulted in the Associate Degree Program in QCR.

The foundation for the Associate Degree in QCR was taken from a similar program initiated at San Diego City College just two years earlier. With the help of quality and reliability management of General Dynamics - Convair located at CKAFS and San Diego, many of the curriculum courses used at San Diego were incorporated in the new program. Additional courses such as Contamination Control and Value Engineering were added to meet the requirements of the local area. The effects of this concerted effort resulted in the following curricula being established and approved by the Board of Education, State of Florida.

QUALITY CONTROL AND RELIABILITY

Freshman Year		Term 1 Credits	2
EG 101	Engineering Drawing (Lab)	3	
IT 101	Industrial Materials and Processes	6	
EG 102	Descriptive Geometry (Lab)		3
IT 102	Testing and Strength of Materials (Lab)		3
MS 113 and MS 114 or MS 105 and MS 110		3	3
PS 201-2	College Physics	3	3
EH 101	Communication		3
EL 102	Fundamentals of General Electricity		3
	Physical Education	1	1
		16	19

Sophomore Year			
QCR 201	Quality Control Concepts and Techniques	3	
QCR 202	Inspection Principles and Techniques		3
QCR 203	Quality Control Engineering	3	
QCR 206	Introduction to Non-Destructive Testing		3
QCR 207	Value Engineering	3	
QCR 208	Contamination Control		3
QCR 211	Reliability Objectives	3	
QCR 212	Quality Control & Reliability Management		3
PSY 220	Human Relations in Industry	3	
EH 242	Report Writing		3
SLS 201-2	Man's Cultural Heritage	3	3
	Physical Education	1	1
		19	19

The problem is apparent: How to make the transition from The Associate Degree to the Masters Degree.

This gap can be closed by the development and implementation of the Baccalaureate program. As co-chairman of the Education Committee and an instructor at Brevard Junior College in the Associate Degree Program, this awareness of need becomes a driving force in my activities.

A curricula has been prepared, approved by the Board of Directors of Canaveral Section, ASQC and is being coordinated with F.I.T. This is the first degree program of this type in the United States and could very easily establish the criteria for future programs. This curricula as shown below will fill the gap between the Associate and Master's Degree programs.

BACHELOR OF SCIENCE DEGREE CURRICULUM IN QUALITY ENGINEERING

FRESHMEN

FALL

E-101	English	3
H-111	Hist of West Civ	3
C-101	Chemistry	3
C-111	Chemistry Lab	1
M-151	Engr Mathematics	5
*QCR-201	Quality Control Concepts and Techniques	3
		18

WINTER

E-102	English	3
H-112	Hist of West Civ	3
C-102	Chemistry	3
C-112	Chemistry Lab	1
M-152	Engr Mathematics	5
*QCR-202	Inspection Principles and Techniques	3
		18

SPRING

E-103	Tech Report Writing	3
H-113	Hist of West Civ	3
C-103	Chemistry	3
C-113	Chemistry Lab	1
M-153	Engr Mathematics	5
*QCR-203	Quality Control Engineering	3
		18

SOPHMORE

FALL

E-203	Survey of Eng. Lit	3
P-251	Physics	6
P-103	Physics Lab	2
M-251	Calculus & Diff Eq	5
*QCR-206	Intro to NDT	3
		19

SOPHOMORE

WINTER

E-202	Literature	3
P-252	Physics	6
P-203	Physics Lab	2
M-252	Calculus & Diff Eq	5
*QCR-207	Value Engineering	3
		19

SPRING

E-201	Public Speaking	3
P-253	Physics	6
P-303	Physics Lab	2
M-253	Calculus & Diff Eq	5
*QCR-208	Contamination Control	3
		19

JUNIOR

SUMMER

H-201	History of Science	3
*QCR-211	Reliability Objectives	3
**C-201	Intro to Organic Chemistry	3
	Humanity Elective	3
		12

FALL

P-341	Electrical Measurements	3
*QCR-212	QCR Management	3
M-301	Engineering Analysis	3
**QCR-301	CC Analytical Method	3
ME-201	The Study of Statics	3
**QCR-302	Specifications and Tolerances	3
		18

WINTER

P-342	Electrical Measurements	3
**QCR-303	Advanced Inspection Techniques	3
ME-202	The Study of Kinetics	3
ME-301	Kinetic Strength of Materials	3
**QCR-304	Quality Data Systems	3
		15

SPRING

M-455	Vector Analysis	3
**QCR-401	Metrology	3
ME-203	Kinematics and Special Topics	3
ST-300	Intro to Space Technology	3
		15

SENIOR

SUMMER

Summer Term between Junior and Senior years left free for job experience in industry.

FALL

P-403	Thermodynamics	3
M-411	Intro to Statistical Methods	3
P-460	X-Rays and Crystal Physics	3
	Elective	3
**QCR-402	Reliability Theory	3
		15

WINTER

M-412	Statistical Methods II	3
P-404	Thermodynamics	3
**QCR-403	Sampling Inspection	3
**QCR-404	Advanced Contamination Control	3
ME-401	Engineering Materials	3
		15

SPRING

ME-402	Fluid Mechanics	3
P-350	Optics	3
	Humanity Elective	3
**QCR-405	Vendor Quality	3
	Technical Elective	3
		15

* Courses offered by Brevard Junior College
** Courses to be developed

NOTE All other courses are currently offered by Florida Institute of Technology

An analysis of this proposed degree curricula reveals these significant factors:

1. 42 Qtr. hours of Mathematics
2. 42 Qtr. hours of Physics
3. 51 Qtr.hours of QCR

These courses meet the prerequisites for continued education through the Master of Science Degree in Mathematics (Reliability Option).

SUMMARY

The need for professional growth is being felt not only at Cape Kennedy but throughout the nation. We, at Cape Kennedy, have a unique challenge to offer to our Reliability and Quality personnel the opportunity for this professional growth. Through the Associate Bachelor's and Master's Degree Programs each one of us could obtain the professional upgrading necessary to meet the challenge of our jobs. Even more so, we can meet the challenges to confront us in 1970.