

# AI Talent

## Developing Lifelong Learners via ISO-9001 Quality Assurance

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### Problems

1. With China investing heavily in traditional education, the US lead in AI talent will erode unless we innovate.
2. With rapid advances in AI and other technologies, university-gained skills will become obsolete faster and faster.

### Solution (but with problems)

'Lifelong Learning' has broad consensus as the solution to the above problems, but:

1. Few individuals have the organizational skills or natural self-discipline to do Lifelong Learning.
2. Employers can keep their workers trained, but usually don't prepare them for moving from job to job, which is becoming more prevalent.
3. Our 200-year old paradigm of education may provide a baseline of knowledge, but students graduate with no system to conduct Lifelong Learning

### 'How' to Create Self-Directed Lifelong Learners

ISO-9001 Quality Assurance can scale to any size organization, including a one-person organization doing Self-Directed Learning. A series of pilots have demonstrated this concept and are now showing its feasibility. These pilots were coordinated amongst IEEE, Global Research, Inc., and U.S. Army C5ISR. A technical paper is appended, plus another paper will be released in July 2019 at the conclusion of the current pilot.

Students are taught how to set up their own Quality Management System (QMS) using software templates (Excel at this time). They analyze their Strengths, Weaknesses, Opportunities, and Threats (SWOT), set goals and objectives, store key documents, measure what matters, keep good records, and conduct their own internal reviews. When they miss a mark, they do a root-cause analysis and improve their QMS so it doesn't happen again. They also must show effectiveness of their learning by applying it. There is some admin work, but the benefits should far outweigh the implementation costs, which has been conclusively proven with Quality Assurance. Once they meet all requirements of the QA standard (which may or may not be ISO-9001 in the end), they can seek certification from a 3<sup>rd</sup> part registrar, but then must maintain their QMS to pass annual audits.

Employers will likely offer premium compensation, provided employees maintain their systems. Individuals will use their QMS to discipline themselves to do good planning and maintain their pace of

learning, partly because it may be a job requirements, but also because they know it will help them continually gain the latest skills, in AI or any field.

### **Essential to Our Nation**

Our age-old and expensive education paradigm, which China is investing heavily to duplicate, cannot keep up with the increasingly fast-paced evolution of AI and other technologies. Individuals need to be taught, while in school, to become self-directed learners, then schools need to gradually remove the constraints and support these students until graduation, so they will be prepared to continue on their own. The smartest and most disciplined could become AI experts before their friends (in traditional universities) graduate. A high tech workforce with the latest skills will foster innovation and economic growth. Students achieving certification before graduating high school could then excel in competency-based university degree programs, which more schools are moving toward.

### **Next Steps for Standards**

1. NIST could help gain attention and engagement of QA standards stakeholders in the US, which could lead to development of technical guidance documents or even a new standard specifically for individuals. New standards guidance will also be needed to enable registrars to streamline and reduce the cost of certification, plus also to guide developers in producing software to simplify adoption by individuals.
2. These evolving standards will enable a growing number of operational pilots to further demonstrate the benefits to both individuals, employers, and society.

# Creating Self-Directed Lifelong Learners via Quality Assurance

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A growing number of career fields, especially high tech fields, require continual learning, often referred to as Lifelong Learning. Additionally, since a growing number of employees will move multiple times to new employers and even to new fields of expertise, the employee of the future needs a personal system to manage their own lifelong learning, plus a credential to assure employers they will continue their learning. (1)

A solution to this need is found in the mature field of Quality Assurance (QA), which has been widely implemented in manufacturing over the past few decades and is now gaining adoption in services. QA can be implemented by any size organization, from large corporations down to a single person organization. This paper describes how a single person applied and gained registration to ISO-9001 Quality Assurance for his system for self-paced learning.

## Pilot Demonstration

An initial demonstration of this concept was conducted by the U.S. Army Communications Electronics Research Development Engineering Command, from 2014-2016, which successfully resulted in one of the two initial test participants achieving ISO-9001:2008 certification for his self-paced learning Quality Management System. Two participants, ages 16 and 17, both high school seniors, started the pilot in Sep 2014. They were hired as contractors and paid for their participation. The scope was purposely kept narrow and was for 'customer-assigned self-paced learning,' which would be a subset of the processes of self-directed learning.

## Pilot Objectives

This pilot was undertaken to determine if:

- A one-person organization, with a scope of self-paced learning, could operate a quality management system compliant to the ISO 9001:2008 standard and be registered to this standard
- A young learner, senior in high school, would have the discipline needed to operate a system that conformed to the ISO 9001:2008 standard
- The use of a quality management system would assure that the participant consistently met planned results
- The burden and complexity of ISO-9001:2008 has reasonable prospects of being able to be scaled down to be cost-effective for an individual learner, working on their own, without financial or technical support from a school or employer

## Methodology

A quality manual was developed that conformed to the ISO 9001:2008 standard. The scope of the system was defined as "completion of customer-provided self-paced learning courses." The U.S. Army project leader, serving in the role of the customer, chose all suppliers (of online courses) for the project and selected all of the courses to be assigned to the learners. Because of this the following ISO 9001:2008 exclusions were taken:

- Clause 7.4 as the individual learner did not select any suppliers
- Clause 7.3 as there was no Design and Development function
- Clause 7.6 as there was no measuring equipment used by the individual learner

All procedures required by ISO-9001:2008 were developed and all records not covered under the exclusions were maintained. Two additional

procedures were added, one to cover product realization and one to cover the management review.

The following quality objectives were set:

- Complete course modules efficiently – complete each course and keep required records within the time allotted by the customer.
- Learn course content to desired level of mastery – receive an 80% or better grade for the online assessment at the end of the course
- Complete courses by customer deadlines – on-time delivery

Once a week, the U.S. Army project leader, serving in the role of the customer, selected and assigned an online course module. These courses were all drawn from Alison.com, which provides good time estimates and graded tests for each course.

The “customer order” to the learner was sent via email and included the link to the course and the required date for completion. When the order was received by the self-paced learner, it was entered into the product realization record. At that time the course was assessed to ensure that it complied with the three requirements listed above. A risk assessment was also performed to determine if there was any risk that the course could not be completed by the due date. Once the learner assessed that the order could be completed on time, a commitment email was sent to the customer (the U.S. Army) that the order had been received and that it would be completed by the due date.

Next the learner scheduled a time to complete the course before the due date. The date, start and end time were recorded when the learner took the course. This allowed the learner to determine if he was keeping to the set schedule, to compare the actual time to complete the course vs. the supplier estimated time and to ensure the customer due date was met. The results of the online evaluation were also recorded to track the mastery level. Once the course was completed, a confirmation email was sent to the customer with a copy of the online certificate of completion, which stated the grade received for the course.

All internal audits were conducted by a 3rd party ISO-9001 consultant who was contracted and paid for by the U.S. Army. All findings from internal audits along with any non-conformances in the realization

process were recorded in the nonconformance log. Corrective actions were opened in all appropriate circumstances and effectiveness was assessed.

All metrics generated were monitored and tracked over time to ensure that the planned results were being achieved. The need for additional training, not related to the customer orders (i.e. ISO 9001 training, root cause analysis), were kept in a separate training log and effectiveness was assessed.

## Results

There were a number of growing pains at the beginning of the project. The two students had no knowledge of quality principles and struggled at first with the concepts of: (1) the discipline needed to maintain a quality management system to ISO 9001:2008 standards, (2) having a plan to ensure product realization happens to ensure planned results, (3) the difference between preventative and corrective action, (4) root cause analysis, (5) understanding what the standard actually means, (6) management review and (7) determining effectiveness of corrective actions and training.

After a few months, the independent learner was able to consistently meet planned results as described in the quality objectives, but internal audits still showed that the system itself was not compliant to the standard. The learner began an analysis of all of the corrective actions that had been undertaken and determined that the root cause of the majority of the nonconformances was due to a lack of understanding of the standard itself. Through management review, the need for more in-depth ISO training was identified and approved by the U.S. Army.

After completion of the additional training one of the two learners in the pilot **had his quality management system registered to the ISO 9001:2008 standard, and** without any findings that needed to be corrected before registration was granted. The other student dropped out the pilot before being ready for a registration audit.

## Lessons Learned

- 1) A one-person organization, with a scope of self-paced learning, can operate a quality management system compliant to the ISO 9001:2008 standard and be registered to this standard. This was the single most important objective of the pilot, which given its success, justifies further refinement and piloting of this approach.
- 2) Once the standard and the system were understood, the system did consistently accomplish planned results.
- 3) The knowledge required on the topic of Quality Assurance is significant.
- 4) Self-discipline is still required, but the system works well to get the individual to complete critical processes to minimum requirements and on-time.
- 5) The independent learner struggled, but eventually succeeded, in the following areas:
  - a) Understanding the standard
  - b) Management review
  - c) Corrective action
  - d) Internal audits
  - e) Root cause analysis
  - f) Planning for product realization
  - g) Proving effectiveness of corrective actions
- 6) In a large organization, senior management is responsible to ensure that the quality management system functions as required by the standard. In a one-person organization, the individual must act in both the role of senior manager and performer, which means they have to formally assess their own work. While this was awkward, it was implemented and did work.
- 7) It is important to clarify this pilot never suggested or attempted to prove the full ISO-9001 standard could be applied beyond the pilot to large numbers of individual learners. Rather, this pilot was only used as a proof-of-concept that quality assurance can be applied to an individual learner. The successful registration audit, with no findings, proved this point, opening the way for follow-on pilots to engineer and demonstrate aspects such as broadening the set of processes, cost-effectiveness, certification, and scalability to larger numbers of individuals.

- 8) Given the two points above, a new and customized quality assurance standard should be explored and piloted.

### Possible alternatives to costly Certification

The cost of the registration audit for the one learner was \$3000, which was not an issue for this pilot, but would not be affordable for most learners.

It is important to distinguish between 'achieving' quality and 'assuring' another party of it. Self-directed learners will likely need both; however, due to the high cost of an ISO-9001 registration audit, the follow are lesser but perhaps good enough means for assuring employers a self-directed learner will maintain their Quality Management System and thereby continue learning throughout his or her career.

1. Employers could perform their own evaluations prior to employment.
2. Interim self-certification. An individual could use standard checklists and peer internal audits to gain the confidence to assert conformance. Part of such an assertion would be the agreement to provide access so an employer or team leader could inspect their Quality Management System. This could potentially work well, since the risk and impact of asserting conformance and then being found to not conform would both be high.
3. The cost of ISO-9001 certification could perhaps be reduced substantially via the following means:
  - a) Software could do many checks automatically.
  - b) Common software (known to the registration auditor) could help the auditor understand a system more quickly
  - c) Remote audits could save travel expenses.
  - d) If new registration vendors were to form and gain required credentials for this unique market, the cost structure and resultant competitive prices would likely drop.

## **Next Steps**

To further advance this approach to creating self-directed lifelong learners, the following are suggest next steps.

- a. Explore development of a customized quality assurance standard specifically for individual self-directed learners, inspired by ISO-9001 and other forms of Quality Assurance frameworks such as maturity models.
- b. Conduct further pilots with independent learners to further refine this approach, demonstrate cost and burden effectiveness, scalability to larger numbers, and to provide a basis in existing practice for a new QA standard.

As change accelerates, there is broad consensus that schools need to help students become self-directed lifelong learners. Quality Assurance, as demonstrated by this pilot, can be used as a structured approach by learners to achieving this. The next steps are to develop a customized quality assurance standard and conduct more pilots to refine the approach so it can be cost-effectively scaled.

## **Conclusion**

1. *Creating Lifelong Learners through Quality Assurance, James Schoening, Educational Technology & Society 5(1) 2002, ISSN 1436-4522, [http://www.ifets.info/journals/5\\_1/schoening.html](http://www.ifets.info/journals/5_1/schoening.html)*

