Title	A lean six sigma training providers transition to a 100% online delivery model
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Publication Date	2022-01-01
Publication Information	McDermott, O., Walsh, P., Halpin, L. (2021). A Lean Six Sigma Training Providers Transition to a 100% Online Delivery Model. In: Powell, D.J., Alfnes, E., Holmemo, M.D.Q., Reke, E. (eds) Learning in the Digital Era. ELEC 2021. IFIP Advances in Information and Communication Technology, vol 610. Springer, Cham. https://doi.org/10.1007/978-3-030-92934-3_15
Publisher	Springer, Cham
Link to publisher's version	https://doi.org/10.1007/978-3-030-92934-3_15
Item record	http://hdl.handle.net/10379/17126
DOI	http://dx.doi.org/10.1007/978-3-030-92934-3

A Lean Six Sigma training providers transition to a 100% online delivery model

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Abstract. This research is a case study on SQT a leading Irish Lean Six Sigma training provider and their transition to online training and the digitalisation of their Lean Six Sigma training programs and other associated programs during the COVID-19 pandemic. The changes and challenges in transitioning from the existing classroom-based training model are discussed. A quantitative survey and qualitative interviews were carried out with the customers (trainee's and sponsoring employer organisations/clients) of the Lean Six Sigma trainer provider for 9-12 months. The results of the survey on the customers learning experiences with online Lean training is analysed. The results will demonstrate that the move to online Lean training was positive for both the customers and the training provider in terms of quality of delivery, cost minimisation, elimination of non-value-add travel and classroom time, improved online teamwork, program structure and engagement and enhanced benefits of the application of the learning in the workplace.

Keywords: Digitalisation, Lean, Online delivery, Training, Virtual learning

1   Introduction

The digital era encourages Information Technology (I.T.) in the education sector [1]. Since Coronavirus Disease 19 (COVID-19) outbreak, strict rules of social distancing have been applied worldwide [11], leading to a substantial negative impact on any types of classroom training with interruption of in-house training activities. The COVID-19 pandemic brought significant disruption to Lean training providers. This case study involved SQT - a leading Irish based Lean Six Sigma (LSS) training provider. Business stalled and stopped with the advent of COVID-19, and many H.R. departments and training departments deprioritised internal and external training agendas and initiatives. Uniquely within this training providers supply chain, the customers (clients) or companies who utilise the provider's services and put forward employees for training stayed open during the pandemic. Many of these were deemed essential by the Irish government, e.g. medical devices, food processing, pharmaceuticals etc.[2]. As it was business as usual for these companies, they still had a training need, but one that they nor the training provider could meet in a non-socially distanced classroom. There was also a demand from students who had

completed specific Lean Six Sigma belt training and certification levels, e.g. Yellow Belt and Green belt, to receive training to progress to the next level, e.g. Black belt. In order to remain in business, maintain training pipelines required by customers, deliver training, and keep tutors and admin staff in employment, the decision was made to transfer training online. As much of the LSS training is blended or classroom-based, involved team-based activities, practical exercises, brainstorming and working on a company project (from the trainee's workplace or organisation), this transition was not straightforward [3]. The highly interactive nature of LSS training with the trainer and trainees was something that the provider did not want to compromise as it would affect training quality, training experience and results. As trainees work on an ongoing work-based problem or projects utilising Lean Six Sigma tools, the mentorship and interaction that happens in the training classroom needed to be replicated online [3].

The research questions are:

1. How can classroom training be transferred to a virtual online environment?
2. What were the advantages, challenges and learnings of the virtual training deployment?

2.0 Literature Review

LSS as a continuous improvement methodology is utilised in organisations and can be deployed in services, healthcare, financial organisations. However, this demands that engineers and practitioners have solid basics in LSS. Therefore, it is essential to know about the tools, but it is even more critical to understand how to apply these tools most effectively [4].

2.1 Training design for online training deployment

Online learning tasks should be designed to help learners develop higher-level thinking skills, measure their understanding, and encourage and facilitate sharing ideas and problems within the training content using interactive or collaborative online formats[4]. There are essential criteria within an online classroom: student involvement, task orientation, and innovation and promoting collaborative learning[5, 6]. Thus, there is a need to structure the learning tasks in classroom exercises, albeit virtual. This approach can be taken with LSS teaching as the methodology requires practical tools and skillset application [5]

Problem-based learning (PBL), active learning, blended learning, flipped learning, and Simulation & Gaming are experiential learning formats. These approaches are all conducive to teaching Lean. Moreover, a PBL approach is more involving and enjoyable than more traditional approaches as learning is active[6], [2],[13].

Literature on teaching Lean virtually or in a flipped classroom discusses active learning, problem-based learning, and simulation and games in particular as a means of ensuring experiential learning[6–11]. A sense of community is also central to student engagement and satisfaction in a virtual classroom, and breakout rooms help develop a sense of community[12].

LSS techniques and tools are considered the cornerstones for eliminating waste. Therefore, a Lean training, approach, deployment, education can begin by implementing basic Lean and Six Sigma techniques and tools [10, 13]. Then, LSS thinking evolves towards more complex techniques and tools that are considered to be part of Lean thinking, such as just-in-time (JIT) Kanban setup, poka-yoke (error-proofing), single minute exchange of dies (SMED), and Hejunka (levelling production)[6]. Given this, the research suggests that learning about Lean within a

virtual classroom can aid this learning, application and understanding about LSS.

2.2 Advantages of online and virtual training delivery

Many factors affect an organisations decision to transition to online and virtual training delivery. The advantages include cost savings, shorter training delivery times, flexibility and convenience of training delivery and accessibility, training accessibility, consistency of content and training delivery, enabling and facilitating knowledge management and no need for travel [14]. The disadvantages include lack of human contact, ability to read and respond to body language, resistance to change, confusion about technology, broadband reliability and lack of organisational resources [14].

Selecting the proper infrastructure and content for e-learning is not always the easiest thing [15]. Companies can be confused by many vendors, content providers, and tools available in the market that promise to deliver a complete e-learning solution [16].

3.0 The Research Project

3.1 The Research company

The training provider SQT in this study is one of the largest training providers in Ireland, having been established over 30 years ago. The provider employs over 39 tutors and 13 administrative staff. Before COVID-19, training was delivered in public locations and in-company training classrooms. Depending on the type and level of LSS training being delivered, training courses could last from 0.5 up to 20 days with small classes of approximately 8-12 learners. The providers' typical customers of their services are multinational corporations, Irish indigenous industries, public sector organisations, and employed adult learners interested in professional development and training.

3.2 Research Methodology

The research aimed to identify the effects of moving to an online delivery model and the perceived advantages and disadvantages of virtual delivery training implementation through a case study implementation with a mixed-method qualitative and quantitative analysis.

The case study method is used to facilitate the researcher by focusing on a specific case, learning more about the subject in question, and providing an inductive approach to the relationship between theory and practice [17, 18].

The case study presented enhances the understanding of the adoption of virtual learning and training in an online classroom. For this specific research, the authors have utilised an "intrinsic case study" [19, 20] of a specific company picked up because of its size and reputation and because of the challenges presented to transform their training delivery model completely. The case study research builds an in-depth, contextual understanding of the case, relying on multiple data sources [17] rather than on individual stories as in narrative research. In addition, mixed-method data via quantitative survey data and qualitative interviews were also collected. Attendees were asked to complete the survey questionnaire for each training course. The questionnaires listed a series of questions about the online training delivery mainly measured on a Likert scale such as 5 = Excellent, 4 = Very Good, 3 = Good, 2 =

Adequate, 1 = Poor or other relevant choices as demonstrated in Table 1.

Qualitative semi-structured interviews were carried out with trainers and tutors and admin staff within the training provider to assess the challenges of transitioning to an online LSS virtual delivery module. Finally, survey records, e-learning training materials, virtual learning environments, project outputs, and assessment outputs were also reviewed.

Table 1 - List of Questions in Quantitative Survey

#	Question
1	Considering the general objectives of the course, what was your overall rating? 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
2	How well did the course deliver to the "Learning Outcomes"? 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
3	Will you apply the new skills learned? Yes or No
4	Tech Check in advance of course commencement 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
5	If you contacted the training provider, how did you find Customer Support? (Enquiry response, booking confirmation etc.)? 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
6	Tutor's presentation skills 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
7	Use of technology to aid learning (e.g. Zoom) 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
8	Tutor's ability to answer questions 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
9	Encouragement to participate 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
10	Pace of course delivery 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
11	Ease of access to the virtual classroom (e.g. Zoom) 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
12	How would you rate the clarity of assessment requirements? 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor
13	Would you recommend this course to a colleague? Yes or No

4.0 Results

4.1 Virtual Classroom Design

Technology utilised for delivery is vital to successful online delivery. Having trialled and researched many video conferencing platforms, Zoom was selected as the preferred software. Some of the critical reasons for the training provider choosing Zoom as its delivery platform were as follows: 1) It is lightweight, 2) It is dependable, 3) It is extremely high-quality, 4) It is easy to use, and 5) it can be accessed without

downloading additional software. As Zoom is a web-based video conferencing tool with a local, desktop client and a mobile app that allows users to meet online, with or without video, it was considered the most applicable. A key advantage of Zoom is its ability to securely record and store sessions without recourse to third-party software. Other critical security features include user-specific authentication, real-time encryption of meetings, and the ability to backup recordings to online remote server networks ("the cloud") or local drives, which can then be shared securely for collaboration [21],[22]. Where a company does not allow Zoom, the training provider decided to use alternative platforms such as M.S. Teams and WebEx as the alternative options. The Virtual Learning Platform (VLE) utilised by the training provider before the transition was Moodle, and that VLE was maintained. The training provider implemented practices and guidelines to ensure Zoom meetings and activities were as safe as possible. These measures include the following seven (7) characteristics: 1) using Zoom V5.0, which includes the latest security enhancements, 2) not sharing web links through Zoom during the session, 3) working with small groups and only those registered will be provided with the link to join, 4) sessions are only routed through the U.S. & European Data centres, 5) Join before host option is disabled, 6) A random meeting I.D. is associated with the meeting rather than a personal meeting ID and 7) waiting room functionality has been enabled on all meetings.

A series of technical supports needed to be developed to ensure that both trainers and trainees could access the VLE and video conferencing platforms for the training to run effectively. The following three (3) technical supports were put in place for all virtual programmes to solve and diagnose any potential I.T. issues 1) one week before the course, the training provider schedules a 'Tech Check' with all delegates, 2) on the morning of the training course a member of the training providers support staff logs into the Zoom course ensure that all delegates can successfully log in and all equipment is working correctly, and 3) during the sessions dedicated I.T. support staff are available to deal with any Zoom issues. In addition, a dedicated support email address is used for queries in relation to accessing the VLE prior to, during and post-training sessions.

4.2 Virtual Classroom Delivery

Within 3 weeks or so of the 1st Lockdown all tutors and trainers attended virtual training Design and Delivery courses as part of an immediate plan to transition to an online model. This training was delivered by online educational consultants and was virtual. Within the virtual classroom, students were divided into breakout rooms. The lecturer could recreate the teamwork and brainstorming aspects of LSS in the workplace and physical classroom within the breakout rooms. To evaluate and ensure learning, the lecturer moved between breakout rooms to mentor and advise the students. After each activity, the lecturer would bring the teams back into the virtual classroom, and each group would present their progress. The progress presentation was essential to ensure that the exercise was understood and provide feedback to the students and share ideas within the class. The class sizes remained at 8-12 participants to optimise the trainee experience and ensure that the tutor could give individual feedback, mentoring and support.

Several changes were made to the traditional classroom delivery and blended delivery offered by the training provided to transition to virtual delivery, as outlined in Table 2. Virtual delivery took place over 4-5 months instead of blended delivery and classroom delivery, which took place over 3-4 months and over 1-2 months. The duration of the entire program from training to project submission extended slightly

to 10-11 months, but that was not deemed negative by trainees or the organisational stakeholders involved in the design based on feedback discussed in later sections. Twenty-five online training hours were delivered over sessions consisting of 2.5 hours in duration either on zoom or the client organisation specified platform. The training was delivered via shorter sessions due to feedback that online training required more concentration and was more intense. The course learning and decision to award the appropriate LSS belt level was assessed by submitting an organisational LSS project-based on a problem statement or project proposal and a report demonstrating LSS tool application and usage and a final project poster or storyboard.

Table 2 – Virtual Delivery Characteristics versus Classroom and blended delivery

Course Format	Classroom Delivery	Blended Delivery	Virtual Delivery
Duration of Training	1-2 months	3-4 months	4-5 months
Programme Duration	7-8 months from training commencement to project submission	9-10 months from training commencement to project submission	10-11 months from training commencement to project submission
Structure	2 days and 3 days (public - hotel) 2 days, 1 day, 2 days (inhouse – on site or hotel)	1 day classroom 2 x 2.5 hour virtual sessions (could have 4x2.5) 2 days classroom (could have 1 day) 2 x 2.5 hour virtual sessions	10 x 2.5 hour sessions via Zoom or equivalent company specified digital platform
Training Hours	40 hours	31-34 hours (depending on whether 2 or 3 days classroom)	25 hours
Self Directed Learner Hours (non project related)	10 hours (study/research – includes familiarisation with statistical software)	16-19 hours (as per Classroom + additional pre-reading & course work)	25 hours (as per Classroom + additional pre-reading & course work)
Assessment	100% Project based - Proposal 20% - Report 70% - Storyboard 10%	100% Project based - Proposal 20% - Report 70% - Storyboard 10%	100% Project based - Proposal 20% - Report 70% - Storyboard 10%
Support Platform	Moodle, includes messenger feature	Moodle, includes messenger feature + Zoom (or equivalent)	Moodle, includes messenger feature + Zoom (or equivalent)
Training Aids	Templates, videos, guideline documents, moodle library	As per Classroom + additional pre-read information, video aids and course work instructions	As per Classroom + additional pre-read information, video aids and course work instructions

4.3 Quantitative survey Results

Over 19 LSS courses were delivered to 160 trainees. In addition, the stakeholder feedback from survey data (see Table 3) collated from March to December 2020 (with a 65% response rate) from participants was positive. Therefore, it can be concluded that the quality of the online delivery providers LSS courses has not been compromised by this new model of provision.

Table 3: Quantitative Survey Results

#	Question	Overall Response
1	Considering the general objectives of the course, what was your overall rating? 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	93% gave a rating of "4" or "5" or Excellent."
2	How well did the course deliver to the "Learning Outcomes"? 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	99.5% gave a rating of "5" or "Excellent."
3	Will you apply the new skills learned? Yes or No	98% Replied 'Yes.'
4	Tech Check in advance of course commencement 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	87% gave a rating of "5" or "Excellent."

5	If you contacted the training provider, how did you find Customer Support? (Enquiry response, booking confirmation etc.)? 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	91% gave a rating of "5" or "Excellent"
6	Tutor's presentation skills 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	92% gave a rating of "5" or "Excellent"
7	Use of technology to aid learning (e.g. Zoom) 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	88% gave a rating of "5" or "Excellent"
8	Tutor's ability to answer questions 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	94% gave a rating of "5" or "Excellent"
9	Encouragement to participate 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	91% gave a rating of "5" or "Excellent"
10	Pace of course delivery 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	85% gave a rating of "5" or "Excellent"
11	Ease of access to the virtual classroom (e.g. Zoom) 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	91% gave a rating of "5" or "Excellent"
12	How would you rate the clarity of assessment requirements? 5 = Excellent, 4 = Very Good, 3 = Good, 2 = Adequate, 1 = Poor	87% gave a rating of "5" or "Excellent."
13	Would you recommend this course to a colleague? Yes or No	96% Replied 'Yes.'

96% of trainees stated that they would recommend the LSS training courses to a colleague, with 93% giving the course a rating of excellent and 99.5% responding that the learning and training met the learning objectives. The survey and course feedback was compared with data from classroom-based training courses over the previous four years delivered by the training provider. There was no negligible difference between virtual delivery and classroom-based delivery on comparison of the satisfaction ratings. An average of 4.5 out of 5 was consistently achieved for some based LSS training, and the virtual training satisfaction rating average was consistent at 4.5 out of 5 in the sample selected.

4.4 Qualitative Interview Results

A series of semi-structured interviews were carried out with the training providers, management team, tutors, administration staff, and client organisational management teams. A sample size of 12 was deemed appropriate as it provided a good mix of and representative of the mix of stakeholders under this single case study[23, 24]. The interview questions aimed to ascertain the benefits, challenges, and opportunities with moving to its virtual LSS online delivery. The training providers management team highlighted and reiterated the financial benefits more than once in not conducting "inhouse" or "public" training. Before the virtual delivery transition, courses were held in-house at the training providers larger training facility or were held in various locations around Ireland in hotel conference rooms. There was substantial infrastructure investment costs, but these were mainly upfront once off investments that will pay off over time.

In some cases prior to COVID-19 , training delivery may have taken place on-site within the clients own organisation, but the majority of training was carried out either in the training providers own venue or in hotels around Ireland. The training provider had zero costs in relation to hiring venues or paying tutor travel expenses and accommodation to and from venues with the virtual transition. Client organisations discussed the benefits of "*not having to send 12-13 people offsite for a day or more at a time*". Having spaced out smaller online virtual training slots

meant better utilisation and flexibility with employee time. The training providers management has pointed out that more significant virtual interaction has led to "*further engagement with many stakeholders. This engagement has led to many opportunities for new and innovative suites of programmes across several sectors*".

From an administration point of view, it was commented by a member of the training providers support staff that , "*Since the introduction of virtual delivery, handwritten feedback forms have been replaced by Survey Monkey Evaluation forms, which are integrated into our Management Information System. This is a significant quality enhancement as it allows for immediate feedback, timely analysis and reporting on from both a qualitative and quantitative data perspective*".

Tutors commented on the benefits in terms of "*no travel*", *better work-life balance due to less travel*", "*less administration collecting feedback forms, attendee lists, no submitting of expenses and keeping receipts*".

The challenges were met by the tutors as they had to innovate and work harder - tutors noted that "*they had to work harder to verify learner engagement in the virtual environment*". While Zoom was proven to be a very effective platform, the tutors must be "*very active and engaging*" and "*constantly eliciting learners to contribute comments or feedback*" instead of waiting for them to come involuntarily. In order to enhance the delivery experience, tutors have implemented several strategies, such as using a printed list of attendees to rotate questions through them during the class. This helps to check for a better understanding and confirm clarity. Other challenges were "*ensuring participation and active listening*" -this was overcome by requesting that cameras remain turned on at all times (where possible).

The use of breakout rooms and class polls "*have been critically important to assist with learner interaction and engagement*". While "*sharing the screen and document function has been extremely effective*" for integrating feedback from breakout rooms and exercises.

Many trainees "brought" a problem or project from their workplace to the training in order to work on the project and apply Lean tools as they were learning them in the virtual classroom.

One employer stated, " *the benefits to the organisation have been fantastic, we have had several projects completed and more trainees are getting involved in new projects upon completing their current projects*".

The trainees stated that "*I applied my learning and training to working on our productivity issues and we utilised the Lean tools to help root cause and fix our problems -yielding a 30% improvement*". Also "*I have used the training in my job to gain a Green Belt and I would like to progress to a black Belt*".

On the experience of learning online the trainees stated, "*I had never attended online training before but I was surprised at how much I learned and was able to use in work*".

5.0 Discussion & Conclusion

There were some challenges to achieving an online virtual training delivery. However, the advantages have outweighed the disadvantages in terms of business results and trainer and trainee experiences. Challenges raised were actioned and continue to be reviewed and assessed to improve performance.

The effectiveness of the virtual delivery training was confirmed through feedback from over 160 learners on 19 courses. The course evaluations of the learners rated the courses an average of 4.5 stars out of 5 stars. The quality and standard of the delivery ensured the learning was applicable -with the learnings applied in the LSS project completed by the trainees. 99% of learners reporting that they will apply the new skills learned and 98% reporting that they would recommend their course to a colleague.

Based on qualitative feedback the learning was applied successfully in the workplace of the participants and utilised in projects.

Many customers have confirmed a preference for virtual training (organisation specific) from a future business perspective, and this is a growth area not realised before COVID-19. However many local Irish business LSS networks have given feedback to the provider to express a preference for a blended delivery model of LSS courses once COVID-19 restrictions are lifted. The training provider is confident that virtual delivery will continue to expand and broaden its target market in the long term The training provider will continue to offer a classroom-based model of delivery. A limitation of this study is that the research could not be carried out over a longer timeframe and evaluate the lessons learned and learners' skills acquisition over a more extended period. Future opportunities are to study how effective the application of the training is in the workplaces of the learners.

In LSS training, it is essential to use a suitable training environment for the intended purpose of the training and the participant group, and online training can provide that environment if designed correctly. Therefore, conducting LSS training online and virtually, when designed correctly, can benefit both trainer providers and training participants.

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