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Moderator questions in Bold, Respondents in Regular text.

KEY: **Unable to decipher** = (inaudible + timecode), **Phonetic spelling** (ph) + timecode), **Missed word** = (mw + timecode), **Talking over each other** = (talking over each other + timecode).

Kathy Loughlin: Hello, everyone. My name is Kathy Loughlin and this is my colleague Simon McKee from the operational excellence team in Invest NI. Thank you for participating on our SMED webinar today. The presentation video will run for around 26 minutes and then we'll move onto our Q and A session. If you would like to submit a question for Simon, please do so using the chat function. Thank you.

Simon McKee: Welcome. Hi, my name is Simon McKee. I'm an operational excellence coach with Invest Northern Ireland. Today, we're going to discuss single minute exchange of dies, or the SMED system, our evolutionary way to reduce changeover times on your production lines. You might notice that changeover times in your production lines differ by operator, shift, customer or even product. If so, we need to simplify and standardise changeover times and reduce their overall length. SMED is a powerful tool to make that happen. By the end of this short presentation, you'll be able to explain the concept of SMED and describe the process steps for applying SMED.

We'll cover the following topics today. What is SMED? Applying SMED in your processes and how Invest Northern Ireland's operational excellence solutions team can help you. So, what is the SMED system. The SMED system is the brain child of Shingo Shiegeo, a Japanese industrial engineer and world leading expert on manufacturing practices. He passed away in 1990. While working for the Toyota motor corporation, Shingo recognised that change over times are a form of waste. He used process analysis and planning to reduce change over times on the companies production lines to less than 10 minutes. The goal is reflected in SMED's name. Single digit minutes. It took Shingo over 19 years to develop the SMED system but his pioneering work has saved manufactures far more time in work hours. Companies that have applied SMED have documented change over time reductions averaging 94%.

In practice, it may not always be possible to reduce changeover times to less than ten minutes. Nevertheless, applying these principles is sure to slash change over times in your operations. A good example. Formula one pit stops offer a vivid illustration of the improvements that SMED can deliver. In 1950, pit stops regularly exceeded 4 minutes. Today, they can be as short as 1.82 seconds. Of course, they're big differences in the roles and technology. The pit stop crew in Indianapolis in 1950 were limited to four people, including the driver. They worked with mallets to release the wheels, and had to clean the windscreen in the absence of a full face drivers helmet.

Today, a pit stop crew can number up to 20 people using pneumatic tools to remove the tires. All the same, there are a lot of other differences in process. The crew is in place with equipment really long before the vehicle arrives. They work on many tasks simultaneously and the key to this efficiency is the setup operation. The benefits of SMED go beyond saved time. They include increased safety through the development of standard procedures for completing the process changeover. Productivity has improved due to wasted time reduction. Customer satisfaction goes up due to achieving shorter lead times. Profitability therefore improves due to increased productivity. Flexibility to be able to respond very quickly to changing market demands you need to be able to produce smaller lot sizes and (inaudible 04.38). The organisation in general benefits from all of the above. So other benefits of SMED? We'll have decreased defects, decreased late deliveries and we will have decreased the unused inventory that's lying about the floor, kicking up space and costing money.

So, saying you're focused on the setup operation. The time it takes to change a piece of equipment from the last piece of the production lot to the first good piece of the next production lot. He recognised that the set up operations have two elements, an internal element and an external element. The internal element of a setup operation are the actions that can be performed only while the machine or work station is turned off and production has stopped. For example, changing the chuck jaws on a CNC lathe machine. By shifting as many internal setup operations as possible to external, change over times can be drastically reduced while machines can remain an operation longer, subsequently increasing capacity. The external setup. This, kind of, setup can be done while the machine is still running. For example, (inaudible 06.16) attach to the die can be assembled and sorted while the press is still operating. A bad example I have observed while (inaudible 06.27) SMED process, where the machine had stopped production it took the technician 24 minutes to locate the glue bar from an extremely unorganised store. This is all lost capacity. If the glue bar had been at hand it would have reduced the setup time significantly. Shingo identified four basic steps to a setup operation. The first, preparation. Second, installing and removing tooling and parts. Third, measurement settings and calibrations. And the fourth, and potentially always the longest, trial runs and adjustments.

A preparation step can take up to 30% of the time required for a set operation, before any of the process improvements are made. This step involves locating parts, tools and fixtures, and ensuring they're in place. Checking each to make sure they are in working order and cleaning the machinery and work area. In a traditional setup, parts of the preparation step are done after the machine has stopped. These are non value added activities and should be performed when the machine is still running. Value is only added when the machine is producing good parts. We'll begin our discussion for applying SMED by focusing on the preparation step in just a moment. Once the workplace is prepared, your operators must remove the tooling and parts from the previous production run. Locate the tooling and parts for the next and then installing them onto the machinery. This can take as much as 5% of the setup operation. Generally, the machine must be stopped to do this so it is an internal setup.

Notice from the diagram. This step takes very little time compared to the other steps. This step refers to all the measurements and calibrations that must be made in order to perform a production run such as centring, dimensioning, measuring temperature or even pressure. Although the equipment must often be stopped for a step, the SMED system teaches ways to do these tasks quickly like preparing when the equipment is still running. Finally, the new production run requires a trial run to ensure the calibration s being successful. This involves producing test pieces, inspecting these pieces for quality and making any necessarily adjustments to the machinery. This step is often the longest, taking up for 50% of the setup operation time. SMED aims to eliminate these trial runs to that your production line produces high quality output at the start up.

A key point here. The more accurate your measurements and calibrations are in the previous step the easier the adjustments will be. In a traditional setup, the machine is not making good products until this step is finished. So it's considered part of the internal setup. SMED teaches ways to eliminate this step completely so that the machine makes good products right after it has started up. Each of these steps represent an opportunity to intervene in the production process. Rationalise actions and ultimately and most importantly save time. When you come to applying SMED on your production lines, remember that there are two broad categories for improvement. There's the human factor for preparation and organisation on the part of your operators can bring big gains and then there's the technical flaggers where engineered solutions can help you save time.

Typically, human flaggers are cheaper and faster change than technical ones. You might be tempted to focus on technical factors but focus first on the human ones. A graph shows where you can make the biggest gains. As discussed, human achieve through preparation and organisation takes less time and effort to implement and could reduce the setup by as much as 60%. The technical achieved through the engineering and optimisation takes longer to implement and can cost considerably more or limited gains. Applying SMED. How do we apply SMED to our production lines? Here's a generic example of how you might organise a SMED process. Time horizons will differ between operations but a four week process is reasonable in most context.

We will look at each of these stages in turn but let's just point out a few important features. First, measurement and analysis are key to a successful SMED process. At each stage, we should benchmark how your production line is currently performing and examine how your interventions have improved the performance. Second, recording your new work procedures in a standardised work document is critical. This ensures that you capture the changes you've made at each stage so that they can be followed in the future. This guards against a regression into the wrong work habits. Pre-SMED. Initially, we needed to find a measure the stages within our production line. Work with a team member who performs a setup operation. Obviously, they know it best so it's critical that you discover the issues from their perspective. Keep in mind, simply observing your colleagues may temporarily improve changes over times, a phenomenon known as the Hawthorne effect. Record their work sequence, measure the time it takes to form each element, external and internal, and take note of the distances they travel to perform each task.

Three important tools that are used in collecting data are the stop watch, the camcorder and a camera.

While you're defending each setup operation, keep an eye out for the eight wastes. You can remember them using the pneumonic TIMWOODS. So, T for transportation. Transportation waste occurs when operative must leave their work station to track down the things they need for their job. They might be locating tools, looking for fixtures and fittings or clarifying other details. The specifics will depend on the operation. In any case, these are things the operative could have already at hand. I for Inventory. Are your operatives holding onto excess tock in case of contingency or producing extra output without a specific order? There may be good procedure reasons for them to do so, but they're almost certainly a target for rationalisation. The defined stage is the place to find out why this extra stuff is being produced and how you might change procedures to reduce it. M for motion.

Each action your operatives perform takes time that could otherwise be used in producing good parts. Some actions may even put their health and well-being at risk. The defined stage is a good time to map out the movements your operators perform and established procedural changes that can remove some of these-, some of this waste. W for waiting. You might find that your operatives will often spend time waiting for information such as orders, tools and material to arrive. Note each occasion when they are left waiting during the defined stage. O for over processing. You may find that your operatives are doing more work than is strictly necessarily and thereby holding up the production line.

A common cause is checking that tools are in working order. Keep a note of this, at the defined stage. O for overproduction, you're operatives should only be producing output in response to an order, but some may try to get ahead, of anticipated demand. D for defects, ideally all your input material is transformed into your output through your production line, unfortunately, this is almost never the case. There will be offcuts, scrap material, items that must be reworked, and the unused output from trial runs, and adjustments. Even so, there is plenty of scope to reduce this waste, so keep a tally of it throughout the define stage. The last is skills, and unused creativity, your operators are the best place to recognise where waste is being created. Make sure you consult them extensively in the define stage, and throughout the SMED process.

Improve stage one, once you've defined external and internal elements within your production line, it's time to begin improving their performance. The first step is to separate the internal and the external elements, remember, internal elements are set up operations, that can only be performed, when machine is not running. External elements can be performed when the machine is running. You'll be surprised by how effective separating internal and external elements can be, it can result in setup time reductions of up to 35%, at little additional cost. Here's a look at how you can realise setup time improvements, just by separating internal and external elements. This infographic represents a production line before the define stage, we don't yet know if each operation element is internal or external. These are all done when the

machine is down. Through definition, measurement and analysis, we can discover which element can be performed when the machine is running, and which must be performed when it's not. We can then rationalise each element, external elements, or for setup where operations are performed while the machine is running. Only internal elements are performed when it's stopped. The result, save time. Some opportunities to convert internal elements to external ones include, rationalising transportation, using checklists as part of the standard work, performing functional checks and autonomous maintenance.

Improve stage two. With a little adaptation, some internal elements can be performed as external ones. Let's look at how you might identify and modify these. Naturally, the opportunities for converting internal elements to external ones will differ between production lines. Nevertheless, here are some common opportunities for intervention when simplifying your process. Preparing operating conditions in advance, standardising essential functions, using intermediary jigs, centring, and pre-heating elements. With you team, examine the setup operations for internal elements, that may, with some modification, be performed externally. Prioritise the target, internal elements, by assessing the cost, as measured by the materials, and labour needed to make the necessary changes, and the benefit as measured by the time that will be eliminated from the changeover.

Once you've identified some appropriate internal elements, add them to your external workflows. It may some careful consideration to develop ways to perform these internal elements externally. Make sure you include the new production procedures in your standardised work documents. We looked at some specific examples earlier, but here are some broad techniques for converting internal elements to external ones, advance preparation, jigs, modularise the setup, and modify as necessary. So advance preparation, make sure all the parts are ready in advance of any operation, for example, you could preheat dyes in advance of a changeover. Use duplicate jigs, you can perform alignment and other adjustments in advance of the changeover. Modularise equipment for example, you might replace a printer instead of adjusting the printer head. The printer can be configured for a new part number in advance of the changeover. Modify equipment, for example, you might add guarding to enable safe cleaning when the process is running.

So, when do you improve stage three? Now that you've made the appropriate internal elements external, you can optimise the entire process. This is an opportunity to improve the internal elements, to reduce the downtime for the machine's setup. You can also rationalise external elements to reduce the non-value-added activities that your operators must perform. You'll find that the overall runtime decreases as you improve each element. Once you've rationalised each element, you should discover significant time savings over your initial baseline. Into the control phase, secure your newfound time savings by embedding the new process in your standard work instructions. This is a vital step. I would also add that auditing against your standard work is another good way to make sure that those procedures and the variation in the way the changeovers are being done are, are controlled.

Okay, we'll have a look at a SMED example. In the first phase, this business identified each of the stages on the line, recording the tools, time and operator condition for each, this formed the baseline for any improvements. In the second phase, the business identified which of the said operations they could be convert it from internal to external. According the evolve collective data, we can make out that the machine is idle for 151 seconds during setup, this is lost capacity. Worker is idle for 188 seconds during the runtime, lost opportunity to get ready for the next setup. In the third phase, the business rearranged the setup operations to make sure only external operations were performed while the machinery was running. In the fourth week, the business streamlined each of the streamlined operations to realise even greater time savings. They ensured that all the processes were recorded, in addition of the standardised work document. So, comparison between before SMED, and after SMED, after the SMED technique was applied to the bottleneck operation, the total time taken to perform the operation was decreased by 24 and a half, 25%, from 339 seconds to 256 seconds. The number of components increased from 198 to 258 per day, and a number of components per month from 400, 4950 to 6450. You can see from the table that 70 seconds was removed, with the introduction of palette change between run a and run b, a very simple, but effective solution.

Okay, so that, sort of, finishes me, going through the SMED process, so to get the support you need to implement SMED in your business, Invest NI's Operational Excellence Solutions Team, is a group of dedicated coaches, it's real world business experience. This team can help you with your SMED program. We can help you implement a wide range of initiatives to improve your business's productivity, profitability, and competitiveness. We offer tailored training support, mentoring and coaching, we'll help you promote best practice in your organisation, build your capabilities, and ultimately deliver measurable improvements. Get in touch at opex query at investni.com. Thank you very much for your time, and we hope to hear from you soon.

Kathy Loughlin: Okay, thanks Simon. Before we move onto our Q and A session, there will be an evaluation question on screen. We'd appreciate if you'd take the time to answer this question to provide us with some feedback. Okay, Simon, our first question today is, 'What is the best way to run a SMED quick changeover event?'

Simon McKee: Good question, Cathy. I've been running SMED workshops on site with companies now, I would say, for approximately eight years, and there's two main ways that they're done. As outlined on the presentation, you can do it on a stage over four legs or over eight legs, whichever suits the, the business. That works quite well, but you find sometimes, that it loses a wee bit of momentum, and you don't get everybody there for every single workshop. The most effective and efficient way I have done it is a two-day)mw 27.30). So, you've all the key people there, the decision makers, the people that can help make the decisions, and the people that can drive the changeover reduction forward. Like a two day (ph 27.43) workshop, where you do the measurements, you then go in and you do the analysis, to understand where the wastes are. Then, you're able to put some improvements in place, and then your able, most importantly, to put the control system in place. I think this is probably one of the bigger gaps with changeovers, is, it's that control phase, where we're measuring this standard.

So, if we've agreed a standard, to say the changeovers went from 24 minutes to ten minutes, okay, a little wee bit of variation in there, but you're checking that every single day to make sure that you're within those parameters. And that's traditionally done at a daily morning meeting, and we would have that, as part of the implementation plan, and after that two day event. So, two day event, to me, is the best way to about it, short, sharp and quick.

Kathy Loughlin: Okay great. Our next question is 'What do you see the biggest issue with changeovers in the sectors you work?'

Simon McKee: Yeah, it's clear, I'm sure everybody on the line will say the same thing, changeovers without clear standards. So if you don't have a standard that you're holding yourself accountable for, it's going to drive a massive amount of variation into that, into that task. You'll have different people in different shifts doing changeovers in different ways and the end result is obviously greater time, quality issues, and generally, generally, inconstancies in the way changeovers are being done. So, no standards is to me, the number one.

Kathy Loughlin: Okay. Our next question has just come in, 'Do you use assimilation to train teams on SMED methodology?'

Simon McKee: Yeah, that's another good question. I like that one, yeah. We purchased a system, the SMED Lean Simulation kit from Lean Games, back in 2014, I believe it was. It's obviously been in use now for eight years. We do this on-site, (inaudible 29.56). I suppose the aim there is to demonstrate the principles of SMED and practice the methodology through the simulation before you go out onto the shop floor, because it, it gives people a baseline understanding of what they're trying, trying to achieve. It's based on a simulated machine. We've used it in a wide range of industries, we've done a lot with CNC machining, we've done it in packaging, we've done a lot on food, plastics, construction, just to name a few. S, it's not just for engineering, we use it in a wide-, we've used it in a wide range of sectors. I suppose the machine simulates mechanical, pneumatic and colour, and software alterations, so it pulls in a few different things there, and also, first off, with colour inspection. So all the key principals are pulled in that simulation, so yes, but we do do that, and we can do that on site with companies. If we do just part of that (mw 30.59), two day session, say for talk's sake, we would do the simulation and we would spend the rest of that period of time, out on the shop floor, moving them through the phases, and ultimately standardising and reducing the changeovers for that particular process or machine.

Kathy Loughlin: Okay, no problem. We've just got a question in, just with regard to how do we access the operational excellence support. Again, I would say, contact the opex query email on screen, or again, we have lots of case study, tutorials on the Invest NI website. So Simon, I think that's all the questions addressed. Again, thank you and again, if you would like any further information, please contact the opex query email at investni.com.

Simon McKee: That's brilliant, Kathy. Thank you very much.

Kathy Loughlin: Thank you, Simon. Thank you.

Captions by www.takenote.co.