Logistics and Leadership:
Lifeblood of Engineering, Project and Production Management

Keynote Address
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Greetings and salutations from the community of Walsh University in North Canton, Ohio, the United States of America, to the conference's closing session

- Pozdrowienia i pozdrowienia z kampusu Walsh University w North Canton, Ohio, Stany Zjednoczone Ameryki
- Grüße und Grüße vom Campus der Walsh University in North Canton Ohio, USA
- Salutations et salutations du campus de l'Université Walsh à North Canton Ohio, États-Unis d'Amérique
- Migug ohaio ju noseu kaenton-eissneun wolsi daehaggyo kaempeoseueseo insawa insa

It is an honor and privilege to speak with you today, and I offer my deepest gratitude to

- Dr. Joanicjusz Nazarko and the Conference Chairs
- as well as to the Organizing Committee and the Scientific Committee
- and of course, to EPPM … you humble me today.

A special thank you to The Ministry of Science and Higher Education of the Republic of Poland, and all the Sponsors for your generous and thoughtful support of our efforts to generate and share new knowledge with colleagues from around the world

- which enables EPPM to pursue its purpose of encouraging the exchange of ideas and research in an interdisciplinary manner relating to the engineering, project, and production management.
- This would not be possible without your support, and we hope we are successful, in some small way, to help make the world a better place over the course of our conference.

Thank you.

And to my colleagues,

- Dr. Lukasz Nazarko and soon-to-be Dr. Karolina Iiczyk of the Bialystok University of Technology in the Republic of Poland
- it is always good to see you and collaborate with you!
- Oboje jesteście niesamowici!

Finally, I wish to thank Minister Czarnek, our Minister of Education and Science for the Republic of Poland.

- As you conclude your first year, Minister, I want to thank you for your efforts in your new role
- and for all you have done at the John Paul II Catholic University of Lublin.
- *Qui incrementum dat Deus*

Introduction

In the later part of the 19th century, Polish engineers were supporting a wide variety of engineering projects in South America. Some of the best engineers in the world were called upon to answer this question: Would it be possible to build a railroad line through the Andes Mountains?

As each possibility was examined … the answer ended up always being the same: this is not possible.

You can imagine why: Environmental conditions. Labor. Supply chains. Natural terrain barriers.

But engineers are well known for viewing challenges through the lens of opportunity!

Polish Engineer Ernest Malinowski was just such an engineer … with a reputation that few could match given his more than 40 years of engineering experience.

Malinowski was asked for his views … and he not only thought it could be done but that he must lead the effort!

That's confidence!

So at the age of 60 … he began leading the effort to build the highest railroad line in the world!

And what a railroad that unfolded as it wound through the mountains in a very faraway place.

62 tunnels – one of them is 4,000 feet long rising to over 15,000 feet above sea level!

30 bridges.

Revolutions in the countries stopped work not once, but twice … requiring Malinowski to flee for his life from Peru at one point!

Today … the fact that this railroad line is a great engineering marvel shows how logistics and leadership management serve as the lifeblood of an engineering management project.

And though Malinowski's story reminds us that "one machine can do the work of fifty ordinary men. No machine can do the work of one extraordinary man." (Hubbard, L., *The Roycroft Dictionary and Book of Epigrams*, Roycrofters, New York (1923))

We have seen this time and time again throughout history.

The Romans were great engineers … and they were keenly aware of logistics and less concerned for leadership.

Technology was bothersome to them. The Roman Emperor Vespasian refused to engage in potential advances for fear of resulting unemployment.

Of course, that is not our reality today.

In fact, an engineer unaware of the advances in technology is unlikely to be an engineer for very long as its use is expected – not just desired!

And so here we are today … where are we to go – has technology and "just in time delivery" increased our dependance on supply chains and detailed logistical analysis?

Engineering management as a formal practice emerged in higher education in the earliest parts of the 20th Century.

The breadth of topical areas is astounding:

- From the science of management to the application of leadership
- From supply chain management to product engineering
- From design to operations
- From the management of people to the management of technology

Today, technology serves as an umbrella over every aspect of our work.

With the development of machine learning and artificial intelligence, we should pause and ask ourselves a penultimate question: what is the need for management, let alone leadership, as we build and create new engineering works for the world?

And as we ask that question in our prevailing world we must seek to understand not just what is happening daily, but also what are the long-term implications on the fields of logistics and engineering management?

The global pandemic of 2020-2021 has been devastating in so many ways … the cost in terms of human capital as well as economic calamity has left no sector of the global economy untouched.

In so many ways, this global situation has brought into sharp focus the otherwise invisible linkages with the field of logistics to those practicing in the fields of Engineering Management.

Tonight, I wish to firstly offer a framework and a few contextual definitions for the purpose of this talk.

Next, I will offer some initial reflections on the impact logistics and engineering management may have in the post-pandemic global economy.

Finally, I would like to conclude with how we might respond in our fields that are reflective of "lessons learned" that can be applied to enhance the current professional practices in our disciplines. We begin!

Framework

As unbelievable as it seems, the manufacturing effort of the industrial mobilization of national economies during World War II was accomplished with “over-the fence” management.

In other words, a very particular effort was handled by a very particular project manager.

- I am making a distinction here: a project is a focused effort with a stated end date for a particular deliverable.

- A product, on the other hand, can be thought of as a single unit delivered that has been created to operate for a specific purpose over an often-undetermined amount of time.

When that project was complete, it was thrown “over the fence” to the next project manager as the product moved through the system.

Besides the obvious issues of responsibility and accountability, the customer was completely unable to identify where to go for the resolution of any questions or concerns.

I suppose it would be only fair to offer if the project was simple then perhaps this is not much of a concern because project and product terminology could be used interchangeably.

But these nations were building tanks and airplanes and ships in this matter – a hugely complex and important distinction!

In many industries, this narrow approach to creating a product by a project-manager approach was doable even if less than ideal.

However, for large efforts like we see in the construction industry or in defense or aerospace industries it was soon found to be impossible.

Over time, and particularly during the last three decades, we have seen a seismic shift away from over-the-fence management to sophisticated project management in almost every industry for product development.

This growth has been born out of necessity.

The rapid pace of changing technologies, the advances in materials science, the wide-spread insertion of computer code and algorithms into anything and everything, and the highly specialized approach to the smallest of activities has made it nearly impossible for a single entity to accomplish – from a systems engineering perspective – every aspect of project management.

Sure … if you think of the “T” … perhaps a single engineering manager can move across all of the silos and stovepipes, but it is unlikely to be able to go deep in any particular area unless that happens to be the individual’s area of expertise.

Today, we find one of the most common … if not THE most common … manner of project management is done using the framework that guides this talk: a life-cycle approach.

Gone are the days when, for instance, an R&D organization would proceed without an appreciation and understanding of production even as they are thinking about the fundamental research that is to be conducted.

Gone are the days when the forces of customer expectations, competitiveness, effectiveness, efficiency, and the need for business development and growth are not at the forefront of most leadership throughout any organization.

We could easily move directly towards an examination of organizational change and its impact on project and production management … perhaps we could examine that for EPPM 2021 or IEEE's TEMSCON? … but at this moment I shall return to our focus today: logistics and leadership as the lifeblood of engineering, project, and production management.

But I do think it remains important to understand how we got to where we are … for this has significant implications for understanding the best way forward.

The life-cycle phase model is here to stay … in my view … and the development of products with an eye from cradle to grave is just our everyday environment.

Managing each phase, and the crossovers between phases, over time is an art itself.

Why?

Because most products rarely operate in a vacuum … they operate in a system.

What do I mean by a "system."

Well, that depends doesn't it?

It depends on the user … it depends on the environment … it depends on the outcomes desired … it depends on the open or closed nature of the activity.

For our purposes, may I simply settle on a system being understood for this talk as a collection of subsystems conveyed in such a manner to provide a synergistic output.

Subsystems … gathered in a deliberative way … to produce the effect needed.

In defense terms, we are focused on the outcome desired … this drives the requirements.

Not the other way around.

That is what we will consider a system to be, fundamentally and without complication.

Yes … I know … it is more complicated but let’s set that aside, shall we?

In order for the “system” to work, then, it is likely we will need two principal elements across the entire effort: logistics and leadership.

What do I mean by logistics?

Well, that also depends, doesn’t it?

Without trying to dive too deeply into the distinctions between software systems and material systems, logistics today will mean the maintenance, service, and support required for the development, implementation, supportability, and sustainability of a given system.

The logisticians with us today can better inform us on the deeper aspects of my simplistic understanding … this is not my field of expertise … such as design interfaces, facilities, maintenance planning, manpower and personnel, packaging, supply, training, and transportation.

Yes … all of that matters and so much more.

Which is exactly my point: you cannot have an operating system without the underlying associated logistical activities.

It is, indeed, what gives vitality to the lifeblood of the system … such is my claim today.

We see this in Ernest Malinowski’s building of a railroad in the Andes Mountains.

We see this in the building of new homes in our hometowns.

Without logistics … there is little need for engineering management.

Technology is moving quickly in the fields of robotics, artificial intelligence, data analytics, Internet of Things, and machine learning to name a few.

Logistics is in the background with ever new technological effort.

My own experience with the research and development of unmanned aircraft suggests that we might slow down and make sure we understand second and third order consequences

That is to say, can we innovate, test, and field simultaneously in an efficient manner rather than having to develop systems sequentially over an extended period of time?

The reliance on software and software development throughout the life-cycle of a product, in some sense, requires us to develop in series … although there is much to do if we are going to be serious about risk reduction.

This serves to accentuate the reality that the impacts in many ways across the system will inherently be less understood.

We create a drone, for instance, that can survey farmland … but what is the impact of that on surveyors?

Do they still need to actually “walk the terrain” or simply learn how to do film editing?

Are there things to learn from “being there” that cannot be captured and understood with video?

Looking to another domain, the surface domain, do you recall the near disaster at sea with the Viking Sky cruise ship in March 2019?

I know … remembering anything pre-pandemic is hard!

Anyway, this was a two-year old state-of-the art ship that found itself needing emergency assistance to rescue over 1,000 passengers in the North Sea off the coast of Norway in a massive storm with high, rolling seas.

What happened?

An early analysis from the accident investigation suggests that the ship was low on oil.

Underway and transiting along the coastline, it found itself in the moderate seas.

The oil levels in the ship’s system were reported to the central computers to be “low” as the ship was in transit.

The weather deteriorated and soon the ship was in heavy, rolling seas.

The tossing about created a “slosh factor” in the oil systems which, in turn, triggered an on-board sensor system that oil was now “dangerously low.”

This updated input to the central computers triggered an automated report to the automated propulsion system, which, in turn shut down all engines without any human interaction, notification, or involvement in the decision-making process.

Makes sense to an engineer writing software code in a quiet room with a cup of coffee next to the computer: a lack of oil will destroy the engines so insert a command line to shut them down to prevent any damage.

So there you are … a 750 foot new cruise ship filled with passengers in tossing seas is not unable to maneuver … and became that bottle bobbing away uncontrollably riding from wave to wave.

The engineering questions you likely have are the same as mine:

- At what point in a decision-making process does a human need to have an opportunity to be placed … either in- or on- … the-loop?
    - Remember … the automation “thinks” the oil-level is insufficient for continued safe operation
- How do we write the code that delineates the limits, or boundaries, for Artificial Intelligence combined with Machine Learning to know when to trust, or distrust, human involvement?
    - A Kalman Filter can help us but only in one dimension … an unlikely technical solution for this sophisticated of an environment even as it was likely present in the Viking Sky software suite

The ethical implications of all this as various systems interface with humans is urgently important to understand, as well., and while we won’t have time to explore ethics today I think it is important to appreciate that this must be examined.

And this brings us to understanding engineering leadership … as opposed to engineering management.

While engineering management is understood to be the combination of technical capabilities with leadership skills and knowledge, for today’s purposes I want to challenge us to think about it differently.

Isn’t that the purpose of our Conference?

So, let’s focus on understanding in the context of risk management.

Is it possible to view management as nothing more than leadership without risk?

What are the implications of bifurcating these activities solely based on “risk?”

I offer that it would move us beyond project management … beyond meeting a deadline or a deliverable … into trying to understand in a deeper and more meaningful way the risks involved with the technical decisions being made along the way – much broader than simply the risk associated with delays in achieving technical or operational capabilities.

So let’s recap this opening part to this evening’s keynote discussion:

- We are having to think about management across the entire life-cycle of a product
- A project manager is organizing the effort and is uniquely aware of the entire system … not simply a subsystem
- Logisticians provide the necessary elements to create sustainability within the system
- We are concerned about two roles or functions in the creation of products – applying to either software or material products
    - The Engineering Manager role ensures the system is created on time and knows the risk associated with the various contingency plans across the life cycle of the product
    - The Engineering Leader role assesses the risk down to the sub-component level on how the project unfolds and the product operates
    - Combined, they add the strength of the system in its design and use
- Often, the engineering manager and engineering leader are the same person with the skills and experience to learn when it is appropriate to think and act in the correct role

Implications in a post-pandemic world

It is fair to offer that the global pandemic has impacted both our professional and our personal lives.

We are looking forward to life in a post-pandemic world, but COVID is a virus that has not been eradicated.

So rather than lean on post-pandemic thinking, I find it more useful to think like an Engineer … we are now into Phase 2 of the pandemic.

Even as we took some immediate steps to mitigate risk, we also initiated our problem-solving efforts that resulted in a first-ever vaccine for a coronavirus – thanks to the tireless work of researchers and manufacturers around the world.

We are thankful for those efforts.

Phase 1 of the pandemic was brutal and its effects linger … Phase 2 remains difficult.

The economic impact of COVID is both unquestioned and devastating.

We are experiencing a global slowdown … logistics cycles interrupted with supply and labor shortages … Central Governments intervening in every aspect of its citizens life with lockdowns, restrictions on travel, mandated work shutdowns, and even mandated "one solution for all" personal healthcare solutions.

Engineering projects are disrupted globally.

Timelines often destroyed.

On a positive note, the pandemic brought significant change to the workplace and this is the first implication on future operations for the Engineering Manager.

The Microsoft Corporation CEO has stated we completed a 2-year digital transformation in less than 90 days.

The challenge, of course, has been we were not all ready for this transformation.

From an engineering perspective, there were many questions that have emerged and require reflection.

Engineering leadership, after all, is relationship centric and we see this in some of these questions.

With remote operations we are confronted with trying to understand what people are actually doing … what are their immediate challenges given we are not "on the scene" to witness them …

where might communications breakdown so we can implement mitigating strategies … what are the realistic timeline projections based upon current work speed and response to “surprises” that always find a way into our project planning?

For many, answers to these questions and many others were not to be found in a software application … not in a sophisticated software reporting system … but in the direct engagement with people working on the project.

Isn’t it amazing to think about how much information and awareness we gather simply by being physically “present?”

All of that ended with COVID … yet the job still had to move forward!

So what are the implications going forward for all of us?

Firstly, engineering teams will need to think through project planning with planners are now going to be routinely geographically separated and distributed.

This will likely require a more disciplined approach to time management.

While it is understood that usually an Engineering Manager will spend 50% of the time doing technical work and 50% of their time on management tasks, I think the pandemic will place greater pressures on management tasks and if the time is not managed effectively then it is unlikely that the leader will find success in a timely manner.

It will also place a premium on engineering competency – lead engineers will now hire talent from anywhere on the planet offering more opportunity and upward pressures to focus on the development of new skills for the individual engineer to remain competitive.

This, in turn, will mean engineering managers working from afar will not necessarily have to relocate – they can truly live anywhere and still perform their work.

An engineer living in North Canton Ohio can work for a company in Warsaw, Poland.

Thus, we may see an increase in demand for independent engineers free from corporate HR policies who now “stich together” their work portfolios rather than working for a single company – travelling only when needed.

Finally, this global redistribution of human capital will allow for finding exactly the engineering talent required for a project sourced worldwide – not just the local or even national labor force markets – to meet the needs of specific engineering tasks and reduced overhead expenses for companies during a slowdown in the economy of any sort.

A second implication of the global pandemic on the logistics and engineering managers is the need for even clearer communications.

We all know the importance of stakeholder communication … the pandemic has made the need for more precise transmission even more so.

Today, we examine supply chains and think about the effort of the logistician seeking to forecast production times … which then must be communicated effectively as it will impact downstream every aspect of project management.

But it isn't just about "parts" … it is also about "people."

The global pandemic has had an enormous impact on staffing … disruptions at manufacturing plants everywhere, for example.

This extends beyond the immediate slowdown and carries forward to strategic planning efforts.

How long will this last? When might we see improvements? How often will this reoccur?

Central governments … whose role is to provide for the collective good … play an ever-increasing role in defining parameters that are now constantly changing making it very difficult to plan effectively and efficiently for business across the entire spectrum.

All of this means our ability to communicate effectively as leaders, as planners, as managers, as logisticians, as engineers is urgently important … compounded by an environment with much uncertainty and unpredictability.

Finally, the third implication of the global pandemic is the impact it is having and will continue to have on education and training – the source for upskilling the workforce as well as providing that pipeline of human capital.

One of the unexpected outcomes from the pandemic has been a shattering of expectations – expectations about nearly everything, as a matter of fact.

Prior to this pandemic, our technical workforce generally accepted that if they were prepared and properly trained and educated, then they would have a secure job.

This is foundational because people do understand "their part" as they seek out happiness in their life's work.

We know from polling data that a good job is always ranked near the top for any survey, if not residing in the Number 1 spot, for worker desires.

When Gallup recently asked what attributes were important when considering a new job, employees stated the ability to do what they do best as the most important … followed by work-life balance concerns, stability and then income.

The data also supports what we know intuitively: younger workers place a higher premium on development and learning opportunities than those closer to retirement or who have already obtained their career goals.

Yet, the economic impact of actions taken during the pandemic often eliminated jobs without regard to the education or training of the person.

I think this will have longer-lasting impacts beyond just engineering projects because the labor force will now be more insistent on "future proofing" itself with continuous education.

Historically speaking, I, too, would observe that we are living in the 4th Industrial Revolution as was discussed earlier today in the discussion on emerging technologies.

We have been running at full speed … changes are occurring very quickly … for example, by 2025 we will be short millions of workers in Advanced Manufacturing … and that is likely to impact all of us in our daily and professional lives but it also will impact every person on our engineering teams.

All of this to suggest, ladies and gentlemen, that we will need to think about how training and education impacts the people that will start, continue, and finish nearly every project an engineering manager leads.

Not just "if you have enough" but also "how is it conducted?"

For example, for many in engineering fields, the education is currently centered on group projects … interdisciplinary projects … hands on application of theoretical concepts applied to real-world challenges.

Those pedological approaches, however, must be adjusted to accommodate the wide-spread implementation of hybrid and online education … new modalities bring new manners of teaching and learning.

But while there will be a loss in the exchange of ideas that naturally occurs when we no longer work side-by-side, it is interesting to consider that this may now result in the growth and development of skills sets that can be applied when working on teams, remotely, from around the world.

This brings more questions to answer that will need to be considered in the education and training process.

How do we collaborate effectively? How do we manage time in a manner that ensures the deadlines are met without the pressure that often comes naturally in face-to-face collaboration?

The pandemic has exacerbated access and opportunity … simultaneously.

These three challenges – geographically distributed teams, more effective communications capabilities, and the future of training and education – are the challenges confronting us at the moment and our solutions will serve as the foundation for Next Generation Engineering Management.

<u>Lesson Learned</u>

As we reflect on our profession and the circumstances, we find for ourselves, it is important to recognize what we can control … and what we cannot control.

While we cannot control the spread of the virus or the strategies being considered to fight the virus, we can control the response.

Here, I would like to offer three quick lessons learned from our situation and its impact on our profession.

1. Logistics and Engineering Management serve as the lifeblood to every project … and it begins with taking care of the people that form our teams.

Certainly, we need logistics to bring us the critical parts and pieces … at the right time … delivered to the right place … in working form … so that we can complete our projects.

No logistics … no projects.

But is not just about "things."

We need our managers to orchestrate the effort … to constantly anticipate and look around the corner for potential pitfalls … to develop solutions … to weigh options … to exercise sound judgement to select the next path forward and then mobilize the workforce to be efficient and effective.

We need our leaders to rethink the risk-reward ratios … to be comfortable with less information … to continuously anticipate the unexpected … to inspire confidence and form talent.

2. Logistics and Engineering Managers will need to build into – or bake into – or cook into all of our planning the required training and education for each member of the team.

Our focus is often framed by a Period of Performance and ruled with project tracking tools.

We should consider the need to insert the time, the milestones, and the budget to support professional development that is targeted to making contributions on the current effort and track that effort.

We should consider recurring conversations with our teams on how a project is contributing to personal growth … understanding what is furthering both the project and the careers … and generating workflows and workplans to do both!

3. Logistics and engineering managers should continually reflect on what is really most important.

For most of us, the major disruption in our lives due to the pandemic has been the severing of personal connections.

In the workplace, in our communities, and within our families we have "lost contact" and this has left us with empty space … perhaps a feeling of loneliness … perhaps "all work and no play" sense of imbalance in our own work-life balance.

The pandemic has reminded me that there are things that are more important and that transcend both work and jobs and money … so perhaps we can spend some time reflecting on what does it take to rebuild and sustain our teams in the absence of physical interactions on a recurring, if not daily, basis.

If we are to ensure our teams continue to learn and grow … building capacity for the next – and – more difficult projects yet to come … then guiding our constant response can be a clearly understood set of operating principles that keeps "first things first."

These are just a few of the lessons I've learned … and we know there are others.

Conclusion

We live in exciting times.

Technology continues to transform the work and the workforce.

Our roles are centered on bringing both of those together … and thus making the world a better place.

My best wishes to all of you with this noble effort.

Thank you.