Network Action Learning for Lean Supply Chain Development – Revisiting the Phenomenon of *Kyoryokukai*

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Abstract
This article explores how Network Action Learning carried out in Norwegian high-tech Maritime industry enabled a supply chain network to collaborate both strategically and operationally on lean supply chain development in order to realize quantifiable supply chain improvement. The process describes how the network made use of both organizational and inter-organizational action learning in the settings of a formal supplier association, which transpired across several mechanisms for learning-in-action.

Keywords: Kyoryokukai, Supplier Association, Lean Supplier Development, Network Action Learning, Action Learning Research

Introduction

With the purpose of increasing operational performance and competitive advantage, many manufacturing firms have developed and deployed lean production programmes, with the ultimate goal of creating a culture of continuous improvement (Netland, 2013; Netland and Powell, 2017). Bortolotti *et al*. (2016) highlight the importance of individual firms expanding the scope of internal lean programmes to also include firms in the extended supply network – the so-called extended lean enterprise (Liker and Choi, 2004). A phenomenon that promotes the dissemination of lean thinking and practice throughout the supply network is the *Kyoryokukai*, or supplier association – an institution that has had a significant presence in the Japanese automotive industry – where lateral inter-supplier learning has been reported as a major benefit of belonging to such an association (Sako, 1996).

Liker and Choi suggest that in order to be successful, an extended lean enterprise must have leadership from the manufacturer, partnerships between the manufacturer and suppliers, a culture of continuous improvement, and joint learning among the companies in the supplier network. Based on this proposition, and with particular reference to joint (inter-organizational) learning, the purpose of this paper is to test the Network Action Learning (NAL) approach as means of realizing a successful supplier association. NAL has emerged as an innovative development of Revan's (1982) theories of Action Learning. Coughlan and Coghlan (2011) present NAL as an approach to collaborative strategic improvement, be it either intra-firm or indeed inter-firm improvement, as in the case of the supplier association. In this paper, we present the results of the lean supplier development programme of a large Norwegian company

and six of its strategic / preferred supply partners, where intra- and inter-firm NAL has been the basis for collaborative strategic improvement.

Theoretical Background

In the field of operations strategy, there has been a recent and noticeable shift of focus from continuous and strategic improvement *within* the firm, to collaborative continuous improvement and collaborative strategic improvement *between* firms (Cagliano et al., 2002; Coughlan & Coghlan, 2011). Nevertheless, the Kyoroyukukai, or supplier association, has been an institution that has had a significant presence in the Japanese automotive industry since 1939, when Toyota formed the first supplier association in history (Hayami, 1998 p.77). The Kyoryokukai promotes integration activities amongst its members, such as top-management group meetings, quality awards and audits, and tries to achieve better coordination in the supply network through information sharing (Dequiedt & Martimort, 2004). Hines & Rich (1998) define Kyoryokukai as "*a mutually benefiting group of a company's most important suppliers brought together on a regular basis in order to achieve strategic and operational alignment through the development of awareness, education and implementation programmes designed to achieve both radical and incremental improvements*" (p526). Hines (1994) in fact suggests that Kyoryokukai is the most important factor exhibited by Japanese in building inter-company relationships and creating a world class supplier base, while Rich (1997) adds that supplier associations have enabled radical changes in supplier behaviour and performance, including the rapid introduction of technologies and practices to support time-based competition in consumer markets.

Network Action Learning

Coughlan and Coghlan (2011) propose Network Action Learning (NAL) as a useful and usable approach to collaborative strategic improvement: "*continuous and collaborative improvement are, in essence, processes of action and learning: problems are identified; solutions are created, analysed, selected and implemented; resulting not only in improved operational performance but also in improved capability. A firm with an improved capability is then an organization that has learned"* (p33). The NAL formula, NAL=P+Q+O+IO, captures the process in the context of inter-firm learning, with a particular emphasis on the extended manufacturing enterprise (EME), or indeed the supplier association. Here, P refers to the established knowledge of collaborative improvement, Q relates to the questioning process, and O and IO relate to emerging insights in the organizational and inter-organizational contexts. As such, "*the action learning by the network (NAL) is built on exposing programmed knowledge to questioning, combined with organizational and inter-organizational insights created in action (learning from organizing at home and from organizing away)*" (p69). In order to increase competitive advantage, however, the EME must be capable to exploit this learning. As such, the EME or supplier association must engage in appropriate learning mechanisms in a structured way. We present the NAL approach as an enabler of the necessary intra- and inter-firm learning that is required in order to achieve sustainable, collaborative strategic and operational improvement.

Learning as a core construct of the supplier association

Fruin & Nishiguchi (1993) describe the supply function model at Toyota Motor Co. as evolving from one of an "*extremely dominant Toyota and rather passive suppliers"* in the (pre-) 1950s to one of "*reciprocal long-term contracting, profit sharing and interdependent learning*" thereafter. Such a learning model presents a shift from unidirectional information flows to multidirectional flows of information and learning throughout the inter-firm supplier network. They go on to describe learning as two sorts: "*the accumulated efforts of many individuals to*

improve, and the enhanced capabilities of organizations to harness those improvements" (p232). In the context of the supplier association, this description is valid for both the intra- and inter-firm perspectives, as well as at the micro (individual organization) and macro (supplier network as a system) levels.

Research Methodology

We use action learning research (Coghlan & Coughlan, 2010; Coughlan & Coghlan, 2011) to inquire into the application of NAL as an approach to achieving successful supplier associations, and generate insights into the Kyoryokukai of a Norwegian hi-tech organization serving the Maritime sector. The company has been collaborating in a supplier association with six of its strategic / preferred onshore suppliers over the previous three-year period (2014-2017), during which one of the authors has been an active participant throughout the process.

Action learning research is a related but different form of activity to action learning. Coughlan & Coghlan (2011) suggest that the key to understanding this difference is in making the distinction between learning (through action) and actionable knowledge (e.g. Argyris, 1993). When engaging in action learning, two commitments are relevant: commitment to action and commitment to learning (Marquardt, 2004). There is no expectation, however, that on realisation of these commitments, there will be a redeployment of that learning beyond the group, through creation and sharing of actionable knowledge. As such, action learning research requires one further, related commitment – a commitment to adding to existing actionable knowledge. For action learning research, reflecting on the story of the action is from a theoretical perspective with a view to identifying emergent theory so as to contribute to actionable knowledge.

Lean Thinking and Practice at the Subsea Division of Kongsberg Maritime

Kongsberg Maritime (KM) is a wholly owned subsidiary of Kongsberg Group (KOG). With over 4000 employees across 18 countries, it delivers systems for dynamic positioning and navigation, marine automation, safety management, cargo handling, subsea survey and construction, maritime simulation and training, and satellite positioning. This investigation focuses on the Subsea Division of KM, which hosts the organization's hydro-acoustic activities, developing and delivering underwater sensor systems for mapping, positioning, and communication, fish-finding and catch-monitoring, naval sonars and marine robotics. Our unit of analysis for this investigation is the main office and production site of KM Subsea (located in Horten, Norway) in addition to the network of its six strategic / preferred suppliers.

Faced with pressure from low-cost competitors and increasingly tough market conditions, in 2014 KM Subsea launched its corporate lean programme – The Kongsberg Way, which forms the basis for a holistic lean business system that builds on the 'world class' vision and core values of Kongsberg Group, and aligns the organization towards the objective of successful lean transformation through adopting a set of five fundamental lean principles: Customer Value, Process Stability, Total Quality, Flow Efficiency and Continuous Improvement. Together, these principles provide a common direction towards KM Subsea's goal of sustained lean growth. In 2017, the company received Lean Forum Norway's Lean Enterprise of the Year Award – recognizing the company for successfully applying lean in an extremely complex production process. The award also recognized the efforts that the company has made with lean supplier development thorough the *Network for Supplier Innovation* initiative in the period 2014-2017.

Network for Supplier Innovation: Norway's First Supplier Association

In 2014, in parallel with launching its own corporate lean programme, KM Subsea also established the first known example of Kyoryokukai in Norway. In collaboration with Innovation Norway and the Norwegian Centre for Expertise in Systems Engineering (NCE-SE), KM Subsea selected six of its strategic / preferred suppliers to join the Network for Supplier Innovation (NSI) initiative – with the main objective of achieving collaborative supply chain improvement through establishing a common understanding of lean thinking and practice throughout the supply network. The six companies included in the supplier association were Flaatnes ElectroMek. (FEM), Fosstech, Hapro, Kristiansand Skrufabrikk og Mekanisk Verksted (KSMV), Norautron and Oswo. The relationships between these companies are interesting from the research perspective in that several companies also demonstrate customer-suppler relations (Eg. FEM and Fosstech; KSMV and Oswo), and several are also competitors (Eg. FEM and Fosstech, Hapro and Norautron). Brief company descriptions can be seen in Table 1:

Table 1: Companies in KM Subsea's Supplier Association

Company	Number of employees*	Turnover** (MNOK)	KM Subsea Supplier Classification	Distance from KM Subsea (km)
FEM	13 (10)	22.0 (20.8)	Preferred	30
Fosstech	40 (70)	62.2 (98,6)	Strategic	30
Hapro	225 (263)	416.9 (448.7)	Preferred	150
KSMV	60 (125)	99.4 (206.1)	Preferred	260
Norautron	140 (210)	299.6 (481.8)	Preferred	2
Oswo	50 (90)	130.7 (149.4)	Preferred	2.5

*2017 figures with 2014 in parenthesis. **2016 figures with 2014 in parenthesis.

All six companies in the supplier network as well as KM Subsea as the lead organization have received different forms of lean training to promote action learning – as individuals and in groups, both at home and away. Company representatives have been top level managers (e.g. CEO, CFO), middle managers (e.g. production manager, supply chain manager), and front-line staff (e.g. team leaders & operators). The different learning mechanisms that developed throughout the programme (some sequentially, others concurrently) were as follows:

1. Co-learning lean basics at Lean Lab, Raufoss, Norway
2. Study visits to exemplary lean-enterprises in Sweden, the Netherlands and Germany
3. Individual company consultations
4. Individual company lean self-assessments
5. Inter-organizational lean assessments
6. Extended Value Stream Mapping.

Learning mechanisms typically refer to planned organizational structures and processes that encourage dynamic learning, particularly to enhance organizational capabilities (Coughlan & Coghlan, 2011). The six mechanisms were applied at individual, group, organizational and inter-organizational levels and aimed to initiate, facilitate, monitor and reward learning. Categorically, they exhibited characteristics of cognitive, structural and procedural insight (Docherty *et al.*, 2008).

Lean Lab

Lean Lab is Norway's first and only full-scale training centre for lean. In order to establish a common understanding of the lean philosophy for the inter-firm network, the initiative enrolled the expertise of Sintef Raufoss Manufacturing (SRM) and Lean Lab to give participants (in

this instance top level and middle managers) a simple theoretical introduction to lean thinking and practice, as well as practical training in the simulator. The simulator introduced representatives from all seven participating companies to a selection of basic lean tools and techniques for improvement, including standardized work, 5S workplace organization, single minute exchange of dies (SMED), and andon.

Study visits to exemplary lean enterprises
A number of study visits were arranged during the three-year programme in order to allow participants to go and see real life examples of lean thinking and practice. Company visits included Parker Hannifin (Sweden), Bosch Hinges and Variass Electronics (the Netherlands) and Bosch Rexroth (Germany).

Individual company consultations
Consultants from Sintef Raufoss Manufacturing (SRM) were engaged in supporting the lean implementations at the individual companies in KM Subsea's supplier association – providing learning and organizational development throughout the three-year period. The consultants were financed through project funding from Innovation Norway and KM Subsea – importantly at no cost to the partner organizations.

Individual company lean self-assessments
The SRM consultants also facilitated lean self-assessments at each of the participating companies, including the lead organization. The self-assessment survey instrument was based on Liker's (2005) 14 principles of the Toyota Way, and provided the management teams at each company to assess the perception of the company's behavior in light of the 14 principles. The survey instrument was completed by the individual managers at each company, and the results compiled to illustrate both average scores and the range of responses per company.

Rapid Plant Assessments
The Rapid Plant Assessment tool (Goodson, 2002) was used by inter-firm representatives during gemba walks at each of the participating companies. This allowed participants to assess the state of lean implementations at all companies in the network, 'away' as well as 'at home'. The assessment also provided an additional learning mechanism for reflection and insight.

Extended Value Stream Mapping
Finally, two or more of the participating companies were assembled to carry out an extended value stream mapping of a range of products. A total of four e-VSM exercises were carried out. The lead organization was present during all of the e-VSM sessions – representing the customer – whereas the total number of suppliers varied from product to product (e.g. one supplier in the least instance and three suppliers in the greatest).

Results
Consistent improvement in supplier performance has been measured by the lead organization over the three-year period, including on-time-delivery (OTD) and quality conformance (QC). This is most notable with an average 26.8% improvement in OTD, with also a marginal improvement in QC, as shown in Table 2:

Reflection on the Network Action Learning
The goal of the initiative was to strengthen performance in quality and delivery precision throughout the supplier network. This has been confirmed in Table 2.

Table 2: Results (companies requested anonymity)

Company	OTD % (Before)	OTD % (After)	QC % (Before)	QC % (After)
A	65	99	99.88	99.99
B	76	98	96.39	98.54
C	73	97	99.86	99.52
D	71	91	99.04	99.44
E	75	80	93.98	96.11
F	69	79	98.25	98.00
Average Improvement	**+26.8%**		**+0.72%**	

From the data generated and collected, we have observed how the Network Action Learning approach has provided an ideal platform to foster joint learning in the setting of a supplier association, contributing towards greater performance from the supply network. In this section, we make specific reflections over the Network Action Learning approach that was adopted to foster these improvements, structured around the six learning mechanisms described previously. Table 3 captures the reflection and summarises how, through NAL, the six activities contributed to organizational and inter-organizational learning through cognitive, structural and procedural insights for the network.

In general, the participating companies consider the supplier development programme as "*three interesting and [yet] demanding years*". Though the participating organizations have achieved a number of successes as a result of the lean action learning that has taken place, unfortunately all companies experienced turbulent and testing market conditions in 2015/2016 and many were required to downsize and re-organize their operations in the same period. Any downsizing was of course handled separately to the lean initiative (in light of the Respect-for-Human principle (Sugimori *et al.*, 1977)), though in some cases this no doubt raised speculation amongst a trivial few associates, e.g. select individuals began to portray "*Lean as mean*". However, the CFO at one of the participating companies suggested that being part of the network was a positive measure, and provided "*insight to the other companies in the project that are struggling with the same problems*", which allowed for "*better input to solving the problems*". Discussions with the participants also confirm that there has been a shift from *'us and them'* to *'we'*, with regard to KM Subsea and its suppliers, and indeed the relationships between the suppliers themselves. This reflects an increase in trust and cooperation between the companies in the supplier network. The CEO of one of the participating companies stated "*the programme has fostered good dialogue with KM Subsea*" and that "*experiences have been further transferred to [our] second tier suppliers*".

Table 3: Org. & Inter-org. Learning and Cognitive, Structural and Procedural insights

	Org. / Inter-org. learning	***Cognitive***	***Structural***	***Procedural***
Co-learning lean basics	Exploration away and Exploitation at home	"an eye opener"	"forced many out of their comfort zones"	"we are now able to speak the same language"
Study visits to exemplary lean-enterprises	Exploration away and Exploitation at home	"allowed us to take time for reflection …many takeaways" "Eureka moments" "How do we achieve this [at home]"	"it is difficult to get others on board back home" "establishing QROC to offer quicker response to customer" "inspired to digitalize kaizen boards"	"we should not plan for more than 70% machine utilization"

Individual company consultations	Exploration and Exploitation at home	"it is useful to have new / fresh [experienced] eyes look at the process" "the increased focus on quality is a result of the [lean] work"	"formalization of kaizen teams and implementation of boards" "daily meetings are the secret [to succeed]"	"establishment of specific practices and procedures – daily layered accountability, waste identification forms"
Individual company lean self-assessments	Exploration and Exploitation at home	"understand how we perceive our organizational culture"	"helped us to achieve a lean[er] culture organization-wide"	"created more discussions about competence development" "Never before have we focussed more on competence mapping and development"
Inter-organizational lean assessments	Exploration and Exploitation at home and away	"it's always interesting to go and see how others do it [lean]" "Eureka moments"	"the network offers real [strategic] benefits"	"a common way to systemize improvement work" "updated 5S revision and TPM practices"
Extended Value Stream Mapping	Exploration and Exploitation at home and away	understanding the "extent of [improved] communication that is required" to be successful	"the key is tight integration with the customer"	"established rules and processes for more regular deliveries of smaller bartches"

Lean Lab

Reflections from the participants around the kick-off Lean Lab activity are mainly positive. Many described this as "*an eye opener".* The Lean Lab provided participants with an introduction to fundamental lean knowledge and created understanding of an otherwise largely misunderstood concept. The Quality & HSE Manager from one of the companies states "*it was useful…we were able to think about things we don't necessarily think about otherwise*". Also, considering the sometimes confusing terminology used in lean – Kaizen, Kanban, Hoshin Kanri, etc. – "*we are now able to speak the same language*" is an outcome recognized by the majority of participants. On the other hand, bringing together representatives from six companies that were somewhat unfamiliar with each other beforehand "*forced many out of their comfort zones*". At the beginning of the programme, there was expressed a certain amount of scepticism, particularly amongst the companies that were naturally competing for KM Subsea's business. The VP Supply Chain from one of the suppliers commented "*following the Lean Lab event, we arranged an [unplanned] informal dinner. This led to several interesting discussions around the table and was a first step towards more open dialogue within the network"*. Such an ad-hoc event helped to "*create openness"* – an observation that was recurrent during the social events that proceeded during the three-year programme (particularly during the study visits). For those organizations that had been working with lean for some years (for example one of the organizations had helped to create the Lean Lab already in 2010), the main positive outcome from the initial Lean Lab activity was "*getting closer to the customer and [the] other suppliers".*

Study visits to exemplary lean enterprises

The CEO of one of the organizations summarizes the study visits as "*some interesting company visits…allowed us to take time for reflection…many takeaway*s". For example, the company was "*inspired to digitalize its Kaizen boards*". Referring to the visit to the Quick Response

Manufacturing (QRM) exemplar, Bosch Hinges in the Netherlands, the CFO of another company adds "*in the Netherlands we learned that we should not plan for more than 70% machine utilization [where we have high variation]. Decreasing our planned machine utilization has increased our active spindle up-time".* The study visit to the Netherlands began at the European QRM Centre, at the University of Applied Sciences in Arnhem. This was collectively considered "*more rewarding"* as "*we were given a good theoretical introduction at a university…with knowledgeable instructors".* One of the participating companies implemented a Quick Response Office Cell (QROC) on returning from the Netherlands "*to offer quicker confirmations to call-offs / purchase orders from the customer"*. Another of the participants was especially satisfied with the visit to Parker Hannifin, this time in Sweden. This was particularly due to the fact that one of the SRM consultants was previously employed as Operations Manager / Lean and Quality Manager at this site, which has a long history of lean success. One observation was "*all of the suppliers [to Parker Hannifin] were located within one hour of the site…enabling reduced inventory and increased flexibility…an extremely good example*". This was particularly relevant where all six of the suppliers in the supplier association are located within a short distance from KM Subsea. A challenge with site visits of course is that often "*it is a different type of production to that we do at home*". Furthermore, "*those that have participated in the study visits have seen the effect [of lean], but it is difficult to get others on board back home".* Another participant added that one of the biggest takeaways from the study visits was "*the exchanges (dialogue) with people [from other companies in the network] on the bus or in the pub"*.

Individual company consultations

The individual company consultations provided the opportunity for individual learning 'at home'. The consultants ('coaches') from Sintef Raufoss Manufacturing (SRM) were "*talented*" and "*knowledgeable*", and demonstrated "*a positive attitude to organizational development and learning*". Several of the suppliers have actually entered into agreements with SRM for additional consultation and coaching, beyond the scope of the NSI programme. "*It is always useful to have new / fresh [experienced] eyes look at the process…we thought we were quite good, but now we know otherwise…and to think we operated like that for 10-15 years!"* To foster and support learning at home, a common focus across all of the participating companies has been the establishment of Kaizen (continuous improvement) teams and boards to focus on improving flow (amongst other things) – "*know why not just know how*", daily layered accountability practices (such as daily stand-up meetings) – "*morning meetings are the secret to success*", as well as standardized work and one-point lessons (OPLs) – "w*e use the OPLs actively to train and multi-skill our operators".* One CEO summarizes with "*it has been a long way to go, but now we think differently"*, presenting a form that has been introduced such that operators can proactively identify and eliminate wastes ("*disturbances and annoyances"*) in operations.

Individual company lean self-assessments

The self-assessments based on Liker's 14 principles allowed the companies to "*understand how we perceive our organizational culture*". The results of the assessments allowed the individual organizations to identify areas for improvement, including leadership development, for example. "*The self-assessment created a greater sense of agreement in the organization…greater harmonization…helped us to achieve a lean[er] culture organization-wide*". The CEO of one of the suppliers agrees that the self-assessments led to more in-depth discussion regarding competence building. "*We hadn't discussed our core competances [so much] before*". On the other hand, one of the companies witnessed an extensive variation in scoring in the self-assessment, which demonstrated "*discontent and distrust*" (given the current

"*uncertainty*" of the situation with downsizing the organization, which saw significant lay-offs in 2016). "*It is extremely difficult to implement lean and benefit from it at the same time the company is handling an extreme re-organization and downsizing*".

Rapid Plant Assessments

A key account manager at one of the suppliers suggested that "*it's always interesting to go and see how others do it [lean]*". In several cases this provided participants with "'*Eureka!' moments*". Another participant said that the opportunity to carry out rapid plant assessments (RPAs) within the inter-firm network was "*interesting*", and provided a means to assess "*the state of the union"*. Being able to see what others are doing 'away' allowed participants to reflect over what they had done 'at home' "*What we are doing may be different, but we are certainly on the right path*". The assessment, which was divided into 11 specific lean dimensions, provided participants with "*a way to systemize improvement work and have a positive impact on quality, cost and delivery performance*". One company was "*inspired by another to update its 5S revision checklist and TPM practices*". The timing of the RPA activity towards the end of the three-year period was also beneficial, as the network was "*collaborating more*", was "*less protective*", and no one tried to hide anything – "*this is how it is here".* "*To go around [the partner companies] like this at the end was positive…we were much more familiar with each other…it was a pleasant experience and very educational".* Being more familiar and open to each other also promoted better dialogue – for example it became much easier to pose such questions as "*how did YOU get this to work?"*. The RPA round also gave opportunities to "*identify and share best practices*". An important observation following the round of RPAs is that the majority of participants identify the significance of continuing the collaboration – "*It is only now [after three years] that the network offers real [strategic] benefits*".

Extended Value Stream Mapping

The extended value stream mapping exercises that were carried out allowed for "*increased insight*" into the supply chain activities and performance. One was able to gather much greater understanding of "*extent of [improved] communication that is required"* to be successful. One of the companies was able to "*introduce rules and processes for more regular deliveries of smaller batches to the customer*". There were however limited opportunities for action learning activities following the initial mapping exercises in most other cases, where authorities outside of KM Subsea's Supply Chain Organization were required to carry out changes and improvements. This led to frustrations within the supply network (Eg. "*the value of the [e-VSM] exercise hasn't yet shown itself*", and "*we haven't got so much out if it"*), and has since resulted in an increased focus on Lean thinking and practice at KM Subsea, where an initiative is now in place to foster collaborative, enterprise-wide continuous improvement across the organization's core value streams. The CEO of one of the suppliers summarized this activity as "*the key is tighter integration with the customer*".

Conclusion

Enacting the network action learning formula (NAL=P+Q+O+IO) provides a means for participating firms in a network such as a Kyoroyukukai, or supplier association, to realize quantifiable supply chain improvement both at home and away in a mode that enhances learning. This article presents some of the results of a three-year supplier association in the Maritime sector. The organizational and inter-org. learning that took place has promoted high rates of knowledge acquisition and application within and between the organizations in the network. Furthermore, this type of learning, when fully exploited, has resulted in qualitative changes in employee attitudes, as well as quantifiable improvement in operational

performance. At the end of the three-year period, the COO of one of the suppliers said – "*in the start we were sceptical, very resistant…do we have time for this? Now we always think "is this creating value for the customer?" It has been fun, but now is the time that it really begins".* To conclude, we suggest that Network Action Learning can and should be used by other large organizations to gain benefits from closer collaboration with its strategic and preferred supply chain partners through the establishment of supplier associations that promote joint action learning and continuous strategic and operational improvement.

Acknowledgements
The authors would like to acknowledge the support of the Research Council of Norway (for the project "Lean Management" and research program "SFI Manufacturing"), Innovation Norway (for the project "Network for Supplier Innovation") and the EU Erasmus+ Strategic Partnership "EuroLEAN+".

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