# FARM SUPPLY CHAIN MANAGEMENT IMPROVEMENT THROUGH THE USE OF LEAN, AGILE AND DEVOPS METHODOLOGIES

**Iuliana MARIN[1], Monica-Paula MARIN[2], Carmen Georgeta NICOLAE[2]**

[1]University POLITEHNICA of Bucharest, 313 Splaiul Independenței, District 6, Bucharest, Romania
[2]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: marin.iulliana25@gmail.com

*Abstract*

*Farmers need to manage better the increasing demand of food by scaling their services according to the required capacity and through the use of IT products and services. The process needs to be efficient and sustainable in order to perform safely. Lean, Agile and DevOps are leading workflow models and concepts which can be included in the process to improve the time and quality of product delivery. Agile optimizes the development of software. DevOps combines development with operations, while shortening the life cycle of software development and improves its quality. Lean enhances focus and optimizes the value stream by identifying automation opportunities and collaboration. The article presents the purpose, methodology and goals for supply chain management in farms. Farmers start from ideas and they apply practices and principles until they get the value out of the supply chain. The Lean principles are the basis of the product development flow. The practices start from finding and validating ideas for the Lean product and how it fits in the market. DevOps incorporates many lean principles and focuses on the enhancement of the collaboration between the employees who are responsible for software development and operations. Software development is based on Agile and it has the Scrum and Kanban methodologies for processes, while engineering is based on extreme programming. Methodologies in the farm supply chain management can be considered to be diagnosis instruments that allow evaluation. Farms identify and implement activities which aim to augment the benefits gained through the use of software and methodologies. Additionally, these principles can be used by academics and practitioners in complementary domains.*

*Key words: farms, practices, principles, supply chain, management.*

## INTRODUCTION

Food production needs to keep up with the increase of the world population. The COVID-19 pandemic caused tough market conditions that greatly influence farmers, as well as the business environment. The consequences of the COVID-19 pandemic affect the global economy, but also the behaviour of business and consumers.

The supply chain management in farms requires good decisions at all levels due to the exposure to financial risks. During the past years, software products and services aimed to bring efficiency and accuracy, while lowering expenses and time consumption. Digitalization allows payments to be done online. Many grocery stores started to sell their products online and to offer delivery services due to the COVID-19 pandemic (Baig et al., 2020). The president of dairy farms of Canada stated that

the dairy sector needs to align to the needs of the consumer, because bottlenecks will appear in the supply chain due to the demands from alimentary stores (Dairy Farmers of Canada, 2020). The trajectory of dairy products was also affected due to the shipments that need to undergo several procedures in order to reach many locations around the world. The stock of milk increases, but the price of it will reduce worldwide in the long-run (Uddin, 2020). During the COVID-19 pandemic time, farms undergo a digitalization process that is connection to the Lean, Agile and DevOps workflow models.

An organization which uses the Lean methodology, comprehends the value of customers and concentrated on the key processes that it possesses in order to increase them (Mahajan et al., 2019). Agile project management fits well when the companied need to be innovative and proactive in order to reach the expectations of

their customers. Customers demand until their need is satisfied after the communication process with the support team leads to the successful accomplishment of the associated activities and goals (Loiro et al., 2019). DevOps comprises software development and information technology operations.

Short term goals need to be reached in a short period of time, like a couple of weeks and even days. Agile project management fits well to this situation and value is delivered fast. A successful example is represented by the Scaled Agile which was tested by scaling the business with a number of teams that are placed at multiple locations, leading to the test of novel opportunities for the business to rely on (Romanukha, 2020).According to Dunn-Krahn, a survey done by xMatters digital service platform on 300 participants showed that 90% of them use digital services for buying food, goods, and using banking facilities. DevOps will always be in demand, even in farms, because digital services have to be offered and the consumer's expectations need to be met.

The current paper presents an analysis of the workflow models which are used in farms and how they can mitigate the problems which appear due to the COVID-19 pandemic.

## MATERIALS AND METHODS

The Lean, Agile and DevOps workflow models can be introduced in farms dairy farms in order to meet the needs of the consumers. According to Gartner, the world leading research and advisory company, by 2021 there will be up to 25 billion gadgets which will be connected via wireless networking (Gartner, 2018).

Adrian Cockcroft from Netflix explained in 2015 to chief information officers from various goat farms how DevOps, microservices, Cloud can be used in industry, with the scope to make them adopt these new concepts into their business(The Goat Farm, 2015).

Validation and testing of DevOps embedded projects is done in test farms to select the best approach based on the demands which require the adaption of digitalization (Rajkin, 2020). The link between Lean, Agile and DevOps is given by the fact that Agile is a part of DevOps and DevOps is an extension of Lean. A holistic view is needed to monitor all the components of the farm processes and to have multiple retrospectives to improve as time passes.

Larry Maccherone presented at the 2018 Nexus User Conference the concept called DevSecOpsthat joins development, security and operations throughout integration and delivery of the desired outcomes (Addo, 2020). In this direction, Libelium, a Spanish Plug&Sense platform provider based on sensors for cow feeding, has reported an increase of milk equal to 18% (Curry, 2019).

More farm management solutions, along with their results are presented in Table 1. In Romania, there does not exist any similar software solution which is dedicated to farm management based on the Lean, Agile and DevOps methodologies.

Table 1. Existent farm management solutions

| Farm Management Solution | Country | Results |
| --- | --- | --- |
| High-quality dairy product development (Roald, 2020) | Norway | Suggestions for data-driven innovation by tailoring dietary decisions |
| Amazon Web Services (AWS) | | Milk production and cow delivery predictions |
| Machine Learning | | Multi-phase approach for planning the dairy farms logistics |
| Dairy herd management (BoviSync, 2020) | USA | Labour cost reduction based on the records generated by cow sensors |
| DevOps | | Decisions can be automated |
| Cloud | | |
| Smart herd management software (MilkingCloud, 2020) | USA | Herd, reproductive, reports, feed, health, milking, cost management |
| DevOps Cloud | | Mastitis and calving detection devices integrated in the system |
| Agri-tech and herd improvement (Livestock Improvement Corporation, 2019) DevOps – Microsoft Azure, Azure Stack Cloud | USA | Infrastructure scaling according to customer demand Data management using massive computing tasks |
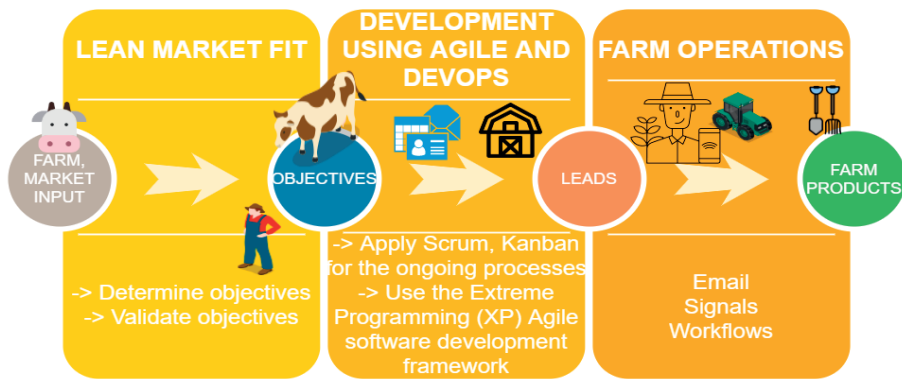
Figure 1. Proposed farm management based on Lean, Agile and DevOps methodologies

The current paper aims to help farmers to sustain the efficient usage of data systems in relationship with the supply chain management, because processes can be delayed and there may not be enough capacity for the farm business goals. The Lean methodology is extended by the use of the Agile project management and DevOps methodology. Software created using DevOps incorporate the Scrum and Kanban methodologies for the decided processes which are part of the Agile project management.

The Scrum methodology consists in dividing the work of programmers into several tasks which are finished in sprints with determined duration (Hidalgo, 2019). The Kanban methodology appeared as part of the Toyota Production System to enhance the production flow through the usage of tickets (Belu et al., 2018). Every production stage corresponds to a Kanban ticket. The process is improved by monitoring the route between stages.

Within the digitalized farm, the centralized nodes are responsible with data acquisition from the farm sensors. The equipment usage pattern is determined in order to improve the power consumption within the farm. A Kanban ticket is produced inside the system when an alarm is triggered. The tickets can be visualized by the user in a dashboard through a web interface.

**RESULTS AND DISCUSSIONS**

The proposed farm management system based on the Lean, Agile and DevOps practices is depicted in Figure 1. The input concerning farm sensors, herd reproductive values, feed,

health, milking and costs are analyse din order to determine objectives and to validate them based on Lean market fit. After setting the objectives, the development of the desired platform is done using the Agile and DevOps methodologies. The process consists in including the Scrum and Kanban methodologies for the processes which run. A Scrum sprint is set for maximum one month and it leads to a clarified scope and the quality of the goals is improved. If the duration would be longer, complexity and risk can rise. Inspections and adjustments are done throughout the process. Along with this, extreme programming is done for the development which is done based on the Agile project management. By involving the DevOps software development methodology, the integration is done between development and farm operations.

The platform enables the farmers and their collaborators to manage the farm, while analysing the signals coming from sensors and controlling the workflows that exist in the farm. The system aims to allow farmers to be aligned to their business context and to have access to information and assistance. This also leads to decreased costs and effort, because initiatives will be reconsidered when going through the whole process which was previously presented.

The management needs to set goals and to analyse the progress towards the desired destination. In this way, the shift is done from seeing vulnerabilities into visualizing the positive aspects that characterize the dairy farm.

The farm management solution developed based on the above principles will help the user understand the impact of factors and how to use

them. The COVID-19 pandemic influenced the life and work style of everyone. By keeping the farm operations updated and in close connection to the user's needs, the success of the business will be higher. Everyone needs to have access to information at a distance of a click and the cloud environment is a proper solution.

## CONCLUSIONS

The COVID-19 pandemic triggered a negative impact upon dairy farms. As a consequence, the farms should adopt new methodologies in their work process and namely the supply chain management, because the user needs change and competition are rarely done by autonomous farms. The supply chain involves several companies throughout the process flow.

The paper presented existent farm management solutions, as well as it proposed a new one which includes the Lean, Agile and DevOps workflow models. The pandemic caused the client behaviour to shift and this triggered the absolute need to analyse it, along with the operations of the farm itself. The risks that exist have to be determined and predicted for the times which will come. This leads to having information and assistance better organized and managed. Moreover, the time will be efficiently used and the focus will be put on product delivery quality.

Academics and practitioners can get involved in determining the Lean market fit, develop-ment of the farm management using Agile and DevOps, and farm operations. In this way, the specialists of tomorrow will be empowered by getting closer to the business context.

## REFERENCES

Addo (2020). To Succeed, DevSecOps Must Actually Include DevOps. Retrieved 15 January 2020, from https://blog.sonatype.com/miracle/to-succeed-devsec ops-must-actually-include-devops.

Baig, A., Hall, B. Jenkins, Lamarre, e., McCarthy, B. (2020). The COVID-19 recovery will be digital: A plan for the first 90 days. Retrieved 10 March 2020, from https://www.mckinsey.com/business-functions/ mckinsey-digital/our-insights/the-covid-19-recovery-will-be-digital-a-plan-for-the-first-90-days.

Belu, N., Ionescu, L., M., Mazare, A.-G., Rachieru, N. (2018). Kanban system based on manufacturing equipment operation monitoring. IOP Conference Series: Materials Science and Engineering, 400(6), 1-9.

BoviSync (2020). Features of BoviSync. Retrieved 17 January 2020, from https://bovisync.com/en/features.

Chimde, L. (2020). Review on impacts of COVID-19 pandemic on life animals and dairy product processing industries of the world. *Insights in Veterinary Science*, 4, 8-24. Retrieved 10 April 2020, from https://www. heighpubs.org/hvsr/ivs-aid1022.php.

Curry, D. (2019). IoT Increases Dairy Farm Productivity by 20 Percent. Retrieved 20 February 2020, from https://www.rtinsights.com/iot-smart-dairy-farm/.

Dairy Farmers of Canada (2020). COVID-19: Dairy Farmers of Canada welcomes the federal government's announcement. Retrieved 15 March 2020, from https://www.newswire.ca/news-releases/covid-19-dairy-farmers-of-canada-welcomes-the-federal-government-s-announcement-837843505.html.

Gartner (2018). Gartner Identifies Top 10 Strategic IoT Technologies and Trends. Retrieved 10 February 2020, from https://www.gartner.com/en/newsroom/ press-releases/2018-11-07-gartner-identifies-top-10-strategic-iot-technologies-and-trends.

Hidalgo, E. S. (2019). Adapting the scrum framework for agile project management in science: case study of a distributed research initiative. *Heliyon*, 5(3).

Livestock Improvement Corporation (2020). Leading the Farm into the Future. Retrieved 21 February 2020, from https://news.microsoft.com/en-nz/2019/08/15/leading-the-farm-into-the-future/.

Loiro, C., Castro, H., Avila, P., Cruz-Cunha, M. M., Putnik, G. D., Ferreira, L. (2019). Agile Project Management: A Communicational Workflow Proposal. *Procedia Computer Science*, 164, 485-490.

Mahajan, M., Chistopher, K. B., Harshan, H., Shiva P. H. C. (2019). Implementation of Lean techniques for Sustainable workflow process in Indian motor manufacturing unit. *Procedia Manufacturing*, 35, 1196-1204.

Rajkin, G. (2020). Embedded DevOps – Addressing Pressing Challenges in Digital Adoption. Retrieved 6 May 2020, from https://www.quest-global.com/ embedded-devops-addressing-pressing-challenges-in-digital-adoption/.

Roald, M. Ø. (2020). How Crayon is Helping TINE Revolutionize the Norwegian Dairy Industry Using Machine Learning on AWS. Retrieved 10 February 2020, https://aws.amazon.com/partners/success/tine-crayon/.

Romanukha, A. (2020). Agile in the Time of COVID-19. Retrieved 10 April 2020, from https://dzone.com/ articles/agile-in-the-time-of-covid-19.

The Goat Farm (2015). Adrian Cockcroft of Battery Ventures – The Goat Farm. Retrieved 10 December 2019, from https://goatcan.do/2015/07/31/adrian-cockcroft-of-battery-ventures-the-goat-farm-episode-8/.

Uddin, M. M. (2020). The impact of COVID-19 on the dairy industry of Bangladesh. Retrieved 13 April 2020, from https://tbsnews.net/thoughts/impact-covid-19-dairy-industry-bangladesh-68569.