“Enhanced data management techniques for real time logistics planning and scheduling”

Deliverable D9.2: Conclusions of the Applied Learning Cycle

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Executive Summary

This report fulfils the requirement of deliverable 9.2. It has examined the effectiveness of communication between LOGISTAR technical consortium partners and is referred to in the DoA as the Applied Learning Cycle. This has been achieved by circulating an internet survey to partners in eight companies who are responsible for developing the technical aspects of the LOGISTAR system, in order to assess their feelings about how well communications have taken place.

A literature survey revealed that communication, both internally and externally, is a major factor in determining the success of a project, and that a multinational consortium can benefit from complementary technical know-how spread over the partners in which strengths and resources can be leveraged, with more outreach and less duplication of effort. It is essential to communicate at regular intervals to update partners about developments, giving time for detailed discussions that can take everyone's opinions into account. The literature also shows that building understanding, trust and relationships can take time so it is important to meet in non-formal situations to establish a networking culture and improve common understanding.

Seventeen partners responded to the survey questions, which showed that, overall, there was a very positive view that communications had been effective and the five work packages had collaborated well together. As far as most of the respondents were concerned, there were no communication, organisational or structural problems with the project. Although partners would have preferred more frequent face to face meeting the impact of Covid-19 has prevented that from happening. This resulted in more frequent email and video call communications than would normally have been expected. The main reasons for these communications were to discuss ideas and finding ways to solve any problems that had arisen, obtaining data and making sure it aligned with the other work packages, coordinating the tasks and ensuring any results matched expectations.

Some respondents felt that the project model was structured almost in a waterfall style, with specifications, knowledge, data, etc. flowing from one WP to another. This meant clear problem specifications and clean complete data in the form needed by some of the technical work packages arrived too late to allow for effective and timely technology development. It's inevitable that because of the Covid-19 pandemic there have been delays, with over 50% of the respondents saying this has caused delays of more than 10%, but there were instances of responses from some partners being later than required, as well as changes in the use case specifications mid-way through the project for living labs 2 and 3.

A number of respondents commented on learning new things as a result of the project, including the difficulties of applying theoretical concepts to real-life problems.

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1. Introduction

The main aim of the LOGISTAR project is to allow effective planning and optimising of transport operations in the supply chain by taking advantage of vertical and horizontal collaboration among different sectors and companies and using increasingly real time data gathered from the interconnected environment such as Internet of things (IoT) devices, smartphones, on-board units and open data. To achieve this, a real-time decision and visualization tool of freight transport will be developed using advanced algorithms, big data analytics and artificial intelligence which will deliver key information and services to the various agents involved in the supply chain such as freight transport operators and their clients.

This aim will be achieved by:

- Identifying logistics related open data sources and harmonising this data together with the other closed sources (i.e. IoT devices and company data)
- Increasing the accuracy planning of logistics operations by applying artificial intelligence techniques for timing predictions and learning preferences of logistics chain participants
- Ensuring a seamless flow of the operations in the supply chain making use of machine learning techniques for identifying potential disrupting events and taking relevant actions to modify any required reconfigurations
- Making the best use of the available resources and provide the best possibilities for horizontal collaboration among logistics agents applying optimization techniques to route planning and scheduling in freight transport networks
- Allowing negotiation among different agents involved in the supply chain taking into account any constraints arising in real-time, making use of distributed constraint satisfaction techniques

The LOGISTAR project consists of 16 partners, of whom 8 are companies and academic/research organisations who are technical partners involved in the development of the LOGISTAR system. These eight partner organisations have between 15 and 20 people working on the development and each have specific responsibilities. There are five work packages, classified as WP2 to WP6, within which this work will take place. Each work package has an individual appointed as the main leader. The eight consortium partners are located in various countries across Europe including Spain, Italy, Germany, Austria and Serbia. This situation presents unique challenges with different cultures, both national and corporate, expertise, backgrounds, experience and even different sizes of company. These differences have the potential to create coordination issues, but these attributes can be a potential strength. The cross fertilisation of ideas in these circumstances often generate innovation.

Work packages 2 to 6 consist of the technical teams involved in the development of the main LOGISTAR system and this report examines the effectiveness in the way these work packages have worked with each other to support that system development. This means assessing the way internal communications have worked. Within the DoA this is referred to as the Applied Learning Cycle. The idea is to set up a continuous learning and feedback loop between the partners in these work packages to ensure a high quality and innovative system is developed.

Each of the five technical work packages is responsible for developing a specific area of the LOGISTAR system as follows:

WP2 – Data gathering and harmonisation

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WP3 – Development of AI-based methods to predict future events, timings and stakeholder preferences in logistics networks, for deployment in the Logistar Living Labs / use cases

WP4 –The design and development of the global optimization system in different logistic situations.

WP5 – Development of automated negotiation and re-optimization techniques

WP6 – Implementation and integration of the services

Although each of the work elements in packages 2 to 5 are discrete, it is essential that the entire system is coordinated into a whole which is the role of WP6. The success of this system is dependent on regular communications with concrete and timely actions amongst the partners

Rather than each work package leader providing an input to this document, a survey was developed in order to obtain the necessary information in a standardised manner and to ensure that the maximum detailed information was obtained. The survey used is attached in Appendix A

2. General working practices in a multinational consortium

There is much literature written about the effectiveness of communication in projects involving multinational consortia. The consensus is that a consortium, generally, can benefit from complimentary technical know-how spread over the partners, and to leverage strengths and resources, with more outreach and less duplication of efforts (Chevrier, 2003) (Egginton, 1996) (Sinha, 2016) (Lipson, 2012). However, crucially, clear communication, both internally and externally, is a major factor in determining the success of a project. Internally, it is essential to communicate at regular intervals to update partners about developments, giving time for detailed discussions that can take everyone's opinions into account. There is also a common theme in the literature that shows the need for a lead organisation to act as a coordinator (Adler, 1986) (Segalla, Fischer, & Sandner, 2000), which the University of Deusto has undertaken for the LOGISTAR project. The literature also states that the greatest difficulty is for the project coordinator and work package leaders to make sure the work is done on time, and to ensure partner members prioritise the project work, when there are other demands on their time (Sackman, Phillips, & Goodman, 1999) (Unknown, 2019). The performance of any consortium is dependent on how well partners work together (Egginton, 1996).

A lack of communication can lead to misunderstandings and distrust. Effective communication means getting information to the right people in a timely manner. However, because a consortium's partners expertise may be in different areas, it is important to ensure each partner understands what is being communicated. Building understanding, trust and relationships can take time so it's important to meet in non-formal situations to establish a networking culture and improve common understanding (Lipson, 2012) (Unknown, 2019). It is inevitable that there will be disagreements but establishing relationships between the consortium partners means it will be easier to find solutions to those disagreements. A key point made in the literature is that communication should be undertaken in the spirit of partnership and respect, supporting each other knowing that it is to the benefit of the whole project.

Knowing each other well can make working arrangements easier. In a case study for a multinational European consortium for an R&D project, four or five project weeks were organised each year for

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face-to-face meetings to ensure the smooth progress of the project. This was supplemented with regular exchanges through electronic media between these face-to-face meetings (Chevrier, 2003). Several papers mention the need to become well acquainted with partners in a consortium. In particular social events organised in conjunction with technical meetings, plus frequent communication such as emails and video conferencing, can enhance a working relationship and enable the successful outcome of a project (Sackman, Phillips, & Goodman, 1999).

In multinational consortia it has been suggested that they are more creative in problem solving than a single national team, but that this can increase ambiguity, complexity and confusion. However, rather than national cultures, literature also suggests that corporate culture and management processes play a larger role, and not to pay attention to national cultural differences (Chevrier, 2003). This paper gave an example of an R&D consortium where partners from Southern Europe tended to extensively express their opinion while those from Northern Europe, particularly Scandinavia, only spoke up when they disagree with what is being said. This, of course, could be a reflection of the individuals involved, rather than a statement of cultural differences. Understanding the various management styles, risk taking, decision making as well as culture all affect how well partners work together (Egginton, 1996).

In interviews undertaken and reported in one of the papers (Chevrier, 2003), multinational teams tended to forget about the nationality of the partners and focus on the technical issues, something that has been replicated in the LOGISTAR project. These interviews also showed that for an effective project, there is a need for team members to have personal qualities such as openness, patience and self-control, again qualities that exist in the LOGISTAR partners.

3. Outcome from the survey

In order to assess the outcome from the Applied Learning Cycle a survey was used to obtain information from each partner working in the technical development of the LOGISTAR system. Seventeen responses were received from eight organisations across the five work packages, and the outcomes are discussed in this chapter. All these responses are subjective and, as shown in the previous chapter, are highly dependent on the culture, background, expertise and personalities of the partners involved.

When asked about the frequency of communication between the various work packages the responses are shown in Table 1 below.

	WP2	WP3	WP4	WP5	WP6
WP2	5.0	3.0	3.0	3.5	4.0
WP3	2.5	5.0	3.6	3.2	3.4
WP4	2.8	3.5	5.0	3.8	4.0
WP5	2.7	3.7	4.3	5.0	3.3
WP6	5.0	3.3	3.7	2.7	5.0

Table 1: Frequency of communication between work packages

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Based on a scale of 1 (rarely) to 5 (very frequently) it is clear that communications have been regular and above average. As would be expected, communication within work packages have been very frequent.

The method of communication has been impacted by the Covid-19 virus which has inhibited face to face meeting. Under normal circumstances there would have been twice yearly progress meetings plus other visits between work packages. The responses to the method of communication are:

- Email 53.0%
- Video calls 35.2%
- Telephone 0.4%
- Face to face 11.4%

As well as emails being the dominant method of communication, clearly the percentage of video calls is probably higher than might be expected as a result of the Covid-19 virus. A comment was made about the volume of emails being sent such that it was very difficult to keep track of what discussions were going on, and which ones applied to which work packages and therefore required a reply.

Within the same work package the level of face to face meetings was higher, as would be expected, and the level of video calls was also slightly higher but this was skewed towards WP2 and WP6 which had more than one organisation involved in the work development. The average percentage responses for communication within work package is shown below.

- Email 25.7%
- Video calls 39.1%
- Telephone 0.7%
- Face to face 34.5%

If WP2 and 6 were excluded then the incidence of face to face meetings increases to 52.2% and the video calls reduces to 17.4%.

The main reasons for these communications were to discuss ideas and finding ways to solve any problems that had arisen, obtaining data and making sure it aligned with the other work packages, coordinating the tasks and ensuring any results matched expectations. These communications were also important to ensure proper integration of the various modules being developed.

However, there was an example that one work package in particular was taking on a role which they were not expecting. WP6 had a major integration role at the technical level but were not expecting to take on the requirement engineering such as the dashboard mockups. This misunderstanding could have been on the part of the partners in WP6, or alternatively a clearer definition of activities at the start of the project would have helped the situation. Some partners felt that more frequent discussions at the technical level and including the stakeholders in these meetings, plus assessing open actions, would have been beneficial and saved time.

It is important to assess the effectiveness of these communications and the responses are shown in Table 2 below.

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	WP2	WP3	WP4	WP5	WP6
WP2	5.0	3.0	3.0	2.5	4.5
WP3	3.4	4.2	2.8	3.2	3.6
WP4	4.0	4.0	4.8	3.3	4.0
WP5	3.3	3.3	3.7	4.0	3.3
WP6	4.3	4.0	4.3	4.7	5.0

Table 2: Effectiveness of communications

Once again, based on a scale of 1 (poor) to 5 (successful), all responses have been very positive in valuing the effectiveness of these communications.

In terms of the timeliness of responses, Table 3 shows the average values bases on 1 (very late) to 5 (rapid).

	WP2	WP3	WP4	WP5	WP6
WP2	5.0	4.0	3.5	2.5	4.5
WP3	3.8	4.0	3.4	3.8	3.8
WP4	4.5	4.5	5.0	3.0	4.0
WP5	3.0	3.3	3.0	4.0	3.3
WP6	4.7	4.3	4.3	3.7	5.0

Table 3: Timeliness of responses

All responses show that requests for actions have been better than the average which has been set at fairly quick.

When asked about how complete the responses to questions and requests, the values are shown in Table 4 below.

	WP2	WP3	WP4	WP5	WP6
WP2	5.0	3.5	3.5	3.0	4.0
WP3	4.2	4.0	3.8	4.4	4.2
WP4	4.8	4.3	4.8	3.3	4.3
WP5	4.3	4.7	4.0	5.0	4.7
WP6	4.7	4.7	4.7	3.0	4.7

Table 4: Completeness of information received

The responses using the scale 1 (very poor) to 5 (complete) showed that all partners in the work packages were happy with the information they received with all responses above average.

There was an almost unanimous comment that communications could be improved by more face to face-to-face meetings, in particular small group meetings to discuss specific parts of the project. Obviously, because of Covid-19 this has been impossible but as in Chapter 2 of this report, it is clear that gaining a better understanding of the partners and their work comes from social situations. There were suggestions that the project structure could have been improved to ensure that more information flow was pro-active rather than reactive. Interestingly, one partner suggested setting up a general chat line covering various topics.

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There was an overwhelmingly positive response to the question of how well the work packages collaborated with each other. However, some respondents felt that collaborations between their work packages and one or two other WPs had worked well but not so well with the remaining WPs. In particular, vague replies to specific questions were mentioned, a lack of clarity on the problem to solve, and that collaboration between WPs could have been deeper. A couple of respondents mentioned that the project collaboration was good but that the project model was based on successive developments of decisions and complete prototypes rather than on a first design followed by further development. i.e. it was structured almost in a waterfall style, with specifications, knowledge, data, etc. flowing from one WP to another. This meant clear problem specifications and clean complete data in the form needed by some of the technical work packages arrived too late to allow for effective and timely technology development. The waterfall approach doesn't particularly suit the modern software development cycle, and there should have been greater agility in the project.

All respondents felt that the technical meetings were run effectively and efficiently, but a couple of respondents mentioned that there should have been more structure and a greater focus on the technical aspects rather than the management and administrative ones. Also, more time should have been invested at the beginning in understanding the needs of the stakeholders.

All also agreed that there were sufficient questions and communications from all work packages, but there were instances with communications becoming "stuck", and at crucial moments an intensive and longer face-to-face meeting would have been useful. One respondent felt that it took longer than necessary to get meetings going, possibly because of the number of attendees involved, but the regular monthly video call was very important.

None of the respondents felt that there were "people problems" and that all partners were responsive and cooperative, though one respondent did comment that it took some people a longer time than necessary to respond to communications, sometimes needing several reminders.

As far as most of the respondents were concerned, there were no communication, organisational or structural problems with the project. One respondent expressed concern that results might be lost and that an exploitation plan should be in place sooner than planned. Another thought that there was weakness in the alignment between the requirements, architecture and implementation which could have benefitted from a technical lead.

There were no specific issues regarding communication, organization, or structural problems in the project. Future projects should have dedicated face-to-face sessions for each use case/ living lab, involving all relevant partners, completed in the first three months, so that the use case needs and the technology needs can be agreed up-front. One respondent said that it is important that each technology partner gets dedicated time with the use case partner during face-to-face meetings, so that both parties can easily discuss and agree what data and information is needed and what output will be produced. One respondent echoed the comments made in chapter 2 about the project involving research groups/universities, software development companies, and companies with logistics needs/stakeholders, with different cultures, ways of working, etc., hence this is a major challenge in maintaining good communication. A lot of delays could have been avoided by having regular meetings with all technical WPs and Ahlers (the WP7 living labs lead), and maybe the stakeholders.

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Looking at the timings, in response to the question about the work package schedule, most said that there have been delays, with most saying more than 10%. The chart in Figure 1 shows the responses provided.

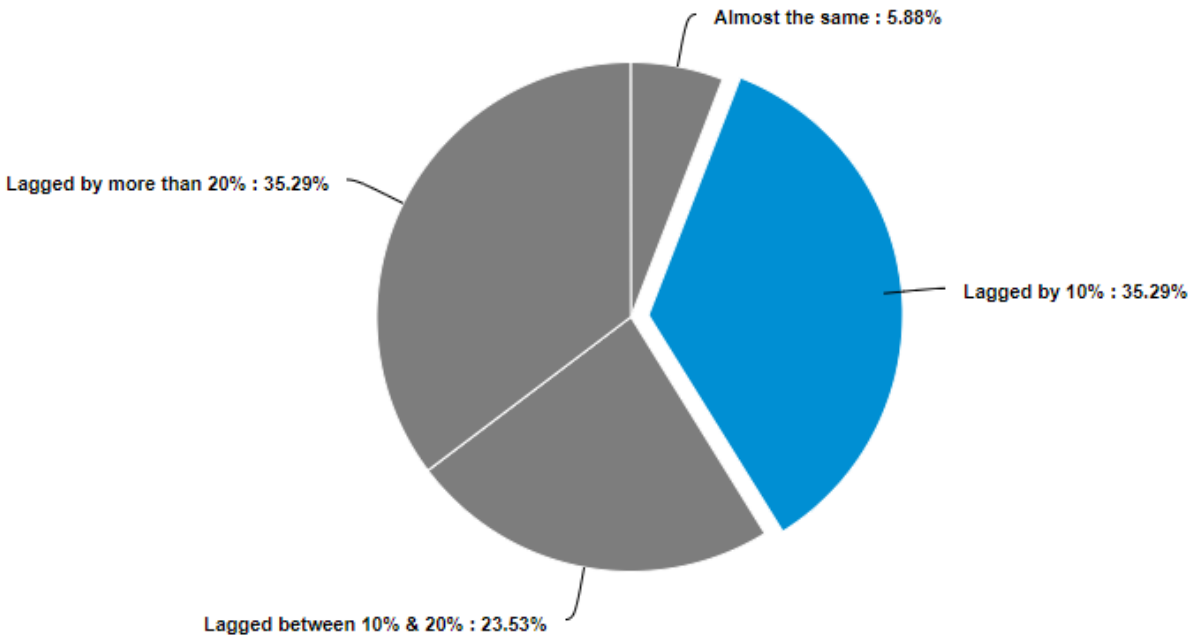

Figure 1: Actual schedule of work package compared to plan

There were a number of reasons for these delays. For the technical partners, the main reasons were to do with receiving data from some of the stakeholders. Midway through the project, use case 2 changed personnel and there was then a more proactive approach adopted. Use case 3 also changed from what was envisaged, and a new stakeholder partner joined the consortium. This meant that although use case 1 could progress, the other two were behind schedule. Thus, the definition of these living labs resulted in many delays, but the major factor was certainly the Covid-19 restrictions. There was also the cascading effect of waiting for certain work packages to complete specific actions before another work package could continue. For one respondent a significant malware attack caused several weeks of delay in software development, and another respondent commented on the complexity of the project and late changes in requirements which created delays.

A number of respondents commented on the fact they have learnt new things as a result of this project including:

- MessageBus architecture, Docker environment, Vaadin Web UI
- Working with large companies in the international area, and the collaboration with people from different nations with heterogeneous technical skills
- Data and metadata management in the logistics domain
- Popular baseline methods for time series prediction, better listening and note-taking
- An artificial intelligence technique called support vector machines
- A great deal about real practical issues in logistics management, rather than the standard academic descriptions of these processes.

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- Preference learning based on KPIs, along with issues to do with fair division between collaborating parties
- Methods of solutions in vehicle routing problems, especially to develop a collaborative model that is not defined in the state of the art.
- Mock-up design
- Google OR-Tools.

One respondent summed up the project by saying “we have learned the difficulties of applying theoretical concepts to real-life problems”.

In terms of lessons learnt and final thoughts, there were suggestions that there should be a clear technical lead and that the monthly video call meetings should have involved working party discussions between work packages rather than presentations of progress. A couple of respondents mentioned that there should be clear objectives for each work package with more detailed planning of the interfaces between work packages. Greater hands-on face to face sessions for technical development, with continuous feedback between all the partners involved, was also repeated as a benefit for future projects. A final thought was don’t underestimate the difficulties of putting together groups with such distinct working cultures.

4. Conclusions

This report has considered the effectiveness of communications between the various technical work packages in the LOGISTAR project in line with the Applied Learning Cycle defined in the DoA.

A literature review has identified a range of factors that can influence the way LOGISTAR consortium partners react to various situations which may affect communications, ranging from both national and corporate culture, attitude to risk, experience, expertise and individual personalities.

An internet survey elicited responses from 17 partners in eight companies across the five technical work packages, which indicated that there was an overall feeling that communications have been very good. Email and video calls were the main form of communication in the recent year due to the Covid-19 pandemic, but it was felt, and confirmed by the literature, that face to face communications in a social situation would have been more beneficial. Responses to questions were effective and there was an overall positive attitude. There were a few critical comments which can be remedied going forward, and there were useful suggestions for future projects involving multinational collaborations.

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Appendix A – Questionnaire sent to technical partners

The applied learning cycle has been defined in the DoA as a continuous feedback loop to ensure that innovation and technology development efforts are market-relevant, and meet end user needs and the functional requirements. This survey has been designed to see how effective the communication has been between the various technical work packages, and whether the applied learning cycle has been successful.

Where questions appear to offer a yes or no answer, it would be appreciated if you would also provide your reasons for that response.

All answers to these questions will be completely anonymous.

In the questions below, where your work package is mentioned in a table please respond as communication within your workgroup

Name:

Company:

WP number:

Description of WP:

Your role in this work package:

Please assess the level of communication you've had with the other work packages and within your own work package (please put x against appropriate column)

	Rarely	Infrequent	Occasionally	Fairly frequent	Frequently
	(a few times a year)	(between 1 & 2 months)	(monthly)	(between 1 & 2 weeks)	(more than weekly)
WP2					
WP3					
WP4					
WP5					
WP6					

Please state how these communications have taken place as a percentage of all communications:

	Email	Video calls	Telephone	Face to face	Other (please state)	Total %
WP2						100
WP3						100
WP4						100
WP5						100
WP6						100

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Please give a few reasons for these communications:

How effective have these communications been (please put x against appropriate column)

	Poor	Fair	Good	Quite good	Successful
WP2					
WP3					
WP4					
WP5					
WP6					

When you have communicated with the work packages and requested information, how timely where the responses:

	Very late	Late	Fairly quick	Quick	Rapid
WP2					
WP3					
WP4					
WP5					
WP6					

How complete was the information you received from the work packages:

	Very poor	Poor	Average	Fairly complete	Complete
WP2					
WP3					
WP4					
WP5					
WP6					

What could have been done to improve these communications:

Do you feel the all the work packages worked collaboratively (if no please elaborate):

Were technical meetings run efficiently and effectively:

Were there enough questions and communications to and from the other work packages:

Have any "people issues" impacted the communication in any way (this is all confidential):

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Did you encounter any communication, organization, or structural problems on this project? If so, how could they be avoided in the future?

On the whole, compared to the plan, the actual schedule of your work package is:

	Response
Ahead	
Almost the same	
Lagged by 10%	
Lagged between 10% & 20%	
Lagged by more than 20%	

What are the reasons for this:

What new technology, method, approach have you learnt from this project:

Do you have any lessons learned or any final thoughts on the communication between work packages that could be helpful for future projects of this nature:

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