



# R@BSLCRCPS

## D6.2 Report on the evaluation protocol

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Abstract:	This deliverable provides the detailed evaluation protocol for the large-scale pilots. It includes Key Performance Indicators (KPIs) derived from measurable metrics (WP1) and a methodology for the timely and efficient evaluation of each LSP and its associated robotic solutions. Moreover, individual evaluation templates and timeplan are provided, as well as information about the composition and envisioned contributions of the LSP Focus Groups.			

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#### 1 Introduction to the evaluation protocol

Deliverable D6.2, "Report on the evaluation protocol", defines the protocol that will be followed to evaluate the large-scale pilots. The report describes the methodology for assessing the implementation and the results of the experiments in accordance with the piloting plan (D6.1 Pilot Planning). Deliverable D6.2 is based on the individual piloting plans of the following pilots:

- a. LSP 1 France Vineyard and vegetable mechanical weeding with CEOL Robot (TERRENA);
- LSP 2 Greece CEOL and retrofitted tractor for spraying operations on table grapes (PEGASUS);
- c. LSP 3 Spain Apple orchards spraying with retrofitted tractor (SERRATER);
- d. LSP 4 The Netherlands Mechanical weeding with Robotti (SmartAgriTechnology).

For the definition of evaluation criteria and the creation of the evaluation templates, information from deliverable D1.4, "Measurable Metrics", is used. Deliverable D1.4, submitted in M6, describes the agricultural, technical and non-technical metrics that will be considered in the evaluation of the large-scale pilots, and are included in this evaluation protocol. These metrics, as well as additional information included in this deliverable, showcase information provided directly by pilot leader organisations.

This deliverable is to be validated and, if needed, adapted throughout the implementation of the evaluation activities for the large-scale pilots, and the submission of the reporting documents: deliverable D6.3, "Report on evaluating the performance of the robotic systems in real-environmental conditions", in M24, M36, and M48.

In the next sections of this document, the following items are included: evaluation methodology, individual evaluation criteria for large-scale pilots, evaluation report templates, timeplan, information on safety issues and the large-scape pilot focus groups.

#### 2 Evaluating Large-Scale Pilots

#### 2.1 Evaluation methodology

In order to implement an efficient and timely evaluation of the large-scale pilots, it is essential to initially define a plan on the means used (e.g., templates, meetings) and the timing of the actions to be taken (e.g., timing of pilot progress reporting, timing of meetings etc.). For evaluating the four large-scale pilots, WP6 leader (AUA) will utilise face-to-face online meetings and individual report templates. According to deliverable D6.1, "Pilot Planning", each large-scale pilot has a pre-defined timeline on the activities and measurements to be conducted. Based on cornerstone activities and their timing, largescale pilots will be invited to report on their activities and achievements reached, as well as problems encountered via online meetings with WP6 and reporting, using report templates, which are described in this deliverable. This work will be done in order to assess performance based on evaluation criteria. Moreover, in the criteria, information is given about the validation of the three minimum viable products (MVBs) of the large-scale pilots throughout the three years of implementation. It is crucial to highlight that pilot leaders will have to follow this evaluation protocol document throughout the whole pilot implementation, study their individual KPIs and be able to report on a monthly and annual basis, as described in the sections that follow in this deliverable.

#### 2.2 Evaluation criteria

The evaluation of the large-scale pilots will be conducted based on:

- a. agronomic, technical and other non-technical KPIs derived from D1.4, "Measurable metrics", with an additional KPI about social acceptance of the robotic solutions;
- b. the expected timeline presented in D6.1, "Pilot Planning";
- c. the measurements defined in D6.1, "Pilot Planning", to take place during pilot activities.

In the tables that follow in sections 2.2.1-2.2.4 (Tables 1,2,3,4), the KPIs are presented, including: (a) their relation to measurable metrics derived from WP1, (b) description/analysis of measurement, (c) timing of measurement and (d) target value/goal.

The KPIs have been grouped in three (3) major categories: agronomic, technical (including: Unmanned Ground Vehicle (UGV), Implements, Farming Controller & FMIS) and nontechnical (including: safety, labour, ethics, economics, social). Moreover, KPIs have been sub-grouped in the tables, using colour coding to indicate KPIs that have to be measured: (a) at the development phase of the pilot and (b) specific times during the project, several times during crop season or during every task/field operation.

These KPIs are going to be monitored using the evaluation templates provided in section 2.3. To add to this, during the lifespan of the pilots, the expected timelines regarding pilot activities and measurements (D6.1) will be evaluated and, if needed, adapted to the specific needs of each pilot. For this reason, large-scale pilots will be monitored in order to: (a) ensure accordance with the pre-defined timeline, (b) indicate possible changes/adjustments, (c) justify the adjustments, (d) ensure that, despite the possible adjustments, all KPIs will be measured and evaluated. This reporting will also be implemented using the evaluation templates, as well as regular online meetings, e-mail communications etc. Regarding the timing of KPI reporting and timeline monitoring, more information is included in section 2.4 of this document (Evaluation Timeplan).

#### 2.2.1 LSP 1 – France - KPIs

Below, the KPIs for LSP 1 are presented.

	AGRONOMIC KPIs						
КРІ	KPI title	Related measurable metric from WP1 (D1.4)	Measurement	Description	Target		
1	Plant damage/ destruction	MET_AGRO_1	Number of damaged or destroyed plants that are not normally expected to be wounded. <u>Timing: at</u> <u>least 2</u> <u>times/year</u>	Throughout the weeding season, analyse one-hectare equivalent of vine by following the UGV on different rows and record the number of damaged or destroyed plants. If a damaged or destroyed plant is detected, record the origin of the damage: cuttings poorly attached to their stakes, not straight row, implements badly adjust (too strong), robotic guidance or other origin.	<3% damage with a good quality of weeding (tool adjusted, and crop management adapt to robotic guidance law)		

 Table 1 KPIs for the evaluation of LSP 1<sup>1</sup>

<sup>&</sup>lt;sup>1</sup> based on measurable metrics derived from WP1

2	A = + = + = + = + = + = + = + = + = + =		A		Atlant
2	Agronomic	MET_AGRO_3	Agronomic	End user or Ecosystem chair	At least
	performance		satisfaction of	feedback with a 1 to 5 scale	feedback
	of the robot		the robotic	(very good, good, ok, bad, very	between "Ok"
			system work	bad).	to "very good"
			Timing: After		
			each field		
			operation		
		linma	TECHNICAL KP nned Ground Veh		
3	Size of robot	MET_TEC_UGV_05	Is the size of	Robot should be suitable to all	Common row
3	suitable for	b	the robotic	vegetables (Sugar beets,	spacing (1,40
	different	2	system	pumpkin, onions, broccoli,	cm to 3 m)
	crops		suitable to the	lettuce etc.), vineyards and	Crop height
	61005		crop?	orchards.	and
			Timing: At the	Record width between the rows	surrounding
			development	of vine and the height where	(pole, net)
			phase	the robotic system cannot pass.	should match
			phase	the robotic system cannot pass.	the UGV
					height.
4	Hardware	MET_TEC_UGV_17	Hardware is	UGV is equipped with a	Yes.
•	present and		present and	connectivity system for data	Robot can
	operational		works on	transmission, GNSS positioning,	operate
	operational		robot.	mobile connection to the cloud	successfully.
			Is there		Comment.
			hardware for		
			data		
			transmission,		
			for GNSS		
			positioning,		
			for mobile		
			connection to		
			the cloud?		
			Timing: At the		
			development		
			phase		
5	Electrical,	MET_TEC_UGV_20	Hardware is	The robotic platform should	Robot can
	hydraulic and		present and	provide electrical, hydraulic and	operate
	PTO output to		works on	PTO output to the implement.	successfully
	the		robot.	Is there hardware to provide	with the
	implement		Timing: At the	electrical, hydraulic and PTO	implement.
			<u>development</u>	output to the implement?	
			<u>phase</u>		
6	Robotics	MET_TEC_UGV_22	GUI	Record all types of messages	The robot
	platform		communicatin	the robotic platform	operator is
	regroups the		g information	communicates.	able to receive
	data to		needed.	Confirmation that	the data s/he
	communicate		Timing: At the	hard/software is available and	needs to make
	with the user		<u>development</u>	functional.	decisions and
			<u>phase</u>		supervise.
7	3-point hitch	MET_TEC_UGV_07	Is the UGV	Do the implements and UGVs	Yes
			equipped with	follow the same Cat or standard	
			an equivalent	for the 3-point hitch dimensions	
			to a 3-point	and lifting capacity.	
			hitch. Does it	Record the UGV 3-point hitch	
			have a 3-point	dimensions	
			hitch (ISO730,		

			CAT I, II, or	Record the 3-point hitch of the	
			III)?	implement	
			Timing: At		
			least once		
			during the		
			<u>project</u>		
			(Before		
			weeding		
			<u>season).</u>		
8	AB lines	MET_TEC_UGV_24	The AB lines	Are AB lines displayed correctly	No need for
	import from		are moved	in the robot management	AB line setup
	GNSS system		from a shape	software?	should be
			file to the	Ensure that AB lines from	necessary on
			robot	commercial systems in use in	the field robot
			management/	2021 can be imported into the	itself.
			planning	robotic system through FMIS	
			software.	and Farming controller	
			Timing: When	interfaces.	
			creating a new		
			path planning		
9	Performing in	MET_TEC_UGV_12	Ability to	Use the heavier tool of the	At least
	wet clay soil		perform a	Large-Scale Pilot (up to 400 kg)	"Suitable" to
	,		mission with	and record the level of easiness	"Very Easy"
			implements in	of the robot to handle it in a wet	assessment.
			the limits of	clay soil (Very Easy - Easy -	
			the robotic	Suitable - Hard - Very hard)	
			systems.		
			Timing:		
			After the		
			weeding		
			season - At		
			least once per		
			<u>year</u>		
10	Performing in	MET_TEC_UGV_13	Performing	Record the slope max of the	Up to 10%.
	terrain slopes		missions	terrain. Record slope where the	
			within terrain	robot cannot pass.	
			slope without	Testing the robot in a terrain	
			an implement	slope of maximum 10% with a	
			and with a	mechanical weeder and a lifted	
			weeder.	tool that doesn't exceed the	
			Timing:	defined weight by the UGV	
			After field	manufacturer.	
			operation – At		
			least once per		
			<u>year</u>		
11	Obstacle	MET_TEC_UGV_03	Detect	Place a heavy (+40 kg min)	The obstacle is
	detection		obstacle and	container in the middle of the	detected.
			stop before	passageway in place of a man:	Collisions are
			obstacle. Can	record if the robot detects the	avoided.
			the robot	obstacle and slow down. Record	
			detect case of	if the robot avoid collision. If not	
			emergency?	record if the collision was	
			Does the	violent.	
			robot avoid		
			collision?		

		1	·		I
			Timing: In the		
			<u>off season –</u>		
			At least twice		
			<u>per year</u>		
12	Autonomy of	MET_TEC_UGV_04	The robot	Let the robot run in a loop until	Time > 8hours
	the whole		should have	it stops, and record time during	
	robotic		an autonomy	the operation.	
	system		of minimum 8		
			-10 hours.		
			Timing:		
			During a		
			specific test –		
			once a year		
13	Use of	MET_TEC_UGV_06	Can the	Work with current common	All
	common		robotic	mechanical weeding tools for	implements
	implements		system use	vineyards (vineyards	usable.
			one type of	ploughshares and knives, disk	At least
			each current	harrow, Kress Fingers, rotatory	feedback
			common	tool mower, ripper) and	between "Ok"
			mechanical	vegetables (hoeing machine).	to "very
			weeding		good".
			implement?	The UGV can tow vineyards	500u .
			Are they	using ploughshares – knives	
			simple to	ploughshares – disk harrows –	
			attach?	Kress Fingers – rotatory tool	
			Timing: Once	mower – ripper.	
			a year after all	nower npper.	
			field	End user and technical chair	
			operation	feedback with a 1 to 5 scale	
			operation	(very good, good, ok, bad, very	
				bad) concerning the easiness to	
				attach those implements	
14	Teach in		Precision of	Teach in: Driving routes can be	Deviation <
14	reach in	MET_TEC_UGV_25	teach in and	0	5cm Feedback
				taught, including patterns of AB	
			efficiency	lines and connecting headland	at least
			Timing: Once	turns.	Efficient
			a year after all	Deviation of the teach in. End	
			<u>field</u>	user feedback with a 1 to 4 scale	
			operation	(Very efficient, Efficient, Not	
				efficient, Unusable)	1.00/
15	Human	MET_TEC_UGV_01	Cases where	Record a description of the	<10%
	intervention		the robotic	intervention and the time	intervention
	in robotic		system cannot	allocated to it. Record the total	time
	work		work without	time used by the end user for	
			human	the whole weeding operation.	
			assistance	Determine the % of	
			Timing:	intervention time in relation to	
			During field	total time.	
			<u>operations</u>		
16	-	MET_TEC_UGV_01	Competences	Record the number of	>10% easier
	Farmer				
	Farmer competences		required for	operations consider as harder	operations
			required for farm workers,	operations consider as harder than driving a tractor and the	operations
	competences		-	-	operations
	competences for using the		farm workers,	than driving a tractor and the	operations
	competences for using the		farm workers, using robotic	than driving a tractor and the competences required to	operations

		[			1
			Timing: At the	than driving a tractor and the	
			end of each	competences required to	
			weeding	achieve them.	
			<u>season</u>		
17	Deviation of	MET_TEC_UGV_02	Deviation of	Record the time of entry and	Percentage of
	the trajectory		the trajectory	the time of exit of 3 straight	deviation from
	of the towing		of the towing	rows of the UGV.	the planned
	system.		system.	Record the speed of the UGV in	trajectory
			Timing: After	those rows.	between 50
			<u>each</u>	Retrieve log of the UGV.	and 100 mm:
			operation		<10%.
					Percentage of
					deviation from
					the planned
					trajectory
					above 100
					mm: <2%.
18	Capacity of	MET_TEC_UGV_05	Condition	In practice, mechanical weeding	50% of
	robot and		where a robot	or spraying can only be done	tractor-based
	tractor to		couldn't work	under certain conditions	operations are
	work under		and where a	(weather, state of the soil (e.g.,	carried out
	different		tractor could.	moisture level), and growth	autonomously
	conditions		Timing: After	stages of both the crop and the	•
			<u>field</u>	weeds), the robot must be able	
			<u>operation</u> –	to work at least in those	
			when it	conditions where a tractor	
			<u>happens</u>	could pass.	
				Record all situations where a	
				robot couldn't work and where	
				a tractor could. Define the	
				expected work.	
				Record all operation of the field.	
				Determine the % of operations	
				carried out by a robot.	050/
19	Blockage	MET_TEC_UGV_08	Detection of	Intentionally cause a blockage	> 95%
	detection and		blockage of	of the tool (with a branch or	blockages
	rectification		mechanical tools and the	stuff on field) record if after 1	detected
				minute of blockage, the robotic	> 90% rectified
			ability to overcome.	system has done nothing to rectify it. Otherwise, record if it	rectified
			Timing:	had worked.	
			During field	Record all unintentionally	
			operations -	caused blockages.	
			At least twice	Determine: % of blockages	
			per weeding	detected % of blockages	
			season	rectified	
20	Equipment	MET TEC UGV 09	Number and	Record all breakdown	90% of all
_	breakdown.		Importance of	(hardware or software) and	mechanical
	Reliability of		the	record the time needed to	breakdowns
	the UGV.		breakdown.	repair and if help from the	are
			Ability to	constructor was needed.	documented
			repair.	Record if the issue is	or can be
			Timing: All	documented.	repaired by a
			along the	Determine:	user equipped
			process –	Number and % of small	for mechanical
1				breakdown: less than 1h of	

21			when it happens	repairs and no need of help from constructor. Number and % of medium breakdown: less than 2 hours of repairs or help of the constructors Number and % of serious breakdown: more than 2 hours of repairs.	interventions by season. 2 small breakdown max per month. 2 medium breakdown max per season. 2 serious breakdown max per 10 years.
21	UGV works in low temperatures	MET_TEC_UGV_10	UGV Performing a mission in low temperatures <u>Timing:</u> <u>During fields</u> <u>operations –</u> <u>for each</u> <u>operation</u>	Record the temperature min of the environment when the robot was used without issues link to temperature.	Be able to work at low temperatures (-5°C).
22	UGV works in high temperatures	MET_TEC_UGV_11	UGV Performing a mission in high temperatures <u>Timing:</u> <u>During fields</u> <u>operations –</u> <u>for each</u> <u>operation</u>	Record the temperature min of the environment when the robot was used without issues link to temperature.	Be able to work in high heat (+40°C).
23	Improvement of guidance and U-turn of the UGV	MET_TEC_UGV_14	Areas for improvement of guidance and U-turn of the UGV <u>Timing:</u> <u>During fields</u> <u>operations –</u> <u>when it</u> <u>happens</u>	Record any movement that the robot does not do the way the farmer wants. Rate their importance: End user feedback with an 1 to 3 scale (Efficient, Not efficient, Unusable). Determine the number of "Unusable" comments.	Efficient. If not, optimize the path planning and reduce pass overs and soil compaction.
24	Level of system deterioration due to weather	MET_TEC_UGV_16	Does the weather significantly deteriorate the system? <u>Timing:</u> <u>During fields</u> <u>operations –</u> <u>when it</u> <u>happens</u>	The robot should be robust with an IP similar to tractors (IP 65-67). Record breakdown caused by the weather. Determine repetitive breakdowns of one component due to weather.	All robotic components are Robust (IP 65-67) or protected to have a similar robustness.
25	Trajectory optimisation/	MET_TEC_UGV_19	Number of pass overs.	Record the number of pass overs during each operation.	< 2 pass overs

		Г	1		
	Reduction of		Timing:		
	pass overs		During fields		
			operations -		
			At least twice		
			per weeding		
			<u>season</u>		
26			Implements	- · · · · · ·	Г
26	Speed of the	MET_TEC_IMP_01	Speed of the	Tow implements that need a	speed difference
	UGV		UGV.	speed between 2km/h to 8	
			Timing: After	km/h.	<1km/h
			each field	Record speed use for each	
			<u>operation</u>	implement. Record speed expectation for	
				this tool.	
				Record speed instruction	
				(speed set in the path planning	
				instructions).	
				[speed difference for each tool=	
				speed expectation – speed use]	
27	Precise height	MET_TEC_IMP_02	Mechanical	Mechanical weeding: Stabilize	<1 cm for both
27	stabilisation		weeding tool	implements to a precise height	deviations
	stabilisation		pass depth.	regardless of the terrain.	ucviations
			Timing:	Pause the robot 3 times on	
			During a field	different location of the fields	
			operation - At	and record the tool pass depth	
			least twice per	in cm. Re do it 10 meters after	
			weeding	each pause.	
			season	Deviation of all the pass depths.	
				Deviation max of two	
				successive path depths.	
28	Implement	MET_TEC_IMP_08	Consumption	Record situations where the	Robotic
	communicatio		of supply	robotic system can optimize its	system can
	n with robotic		sources.	consumption (energy or	optimize its
	platform /		Timing:	consumable).	consumption.
	activating		During field		
	supply sources		operation - At		
			least twice per		
			weeding		
		Fai	<u>season</u> ming Controller 8	2 ENAIS	
29	Presentation	MET_TEC_F-C_15	Virtual map of	Is there a virtual map of the	Presence of a
	of geospatial		the plot.	plot?	virtual map of
	data		Timing: At the		the plot
			development		usable during
			phase.		the operation
					for the end-
					user.
30	Communicatio	MET_TEC_F-C_08	Is it possible	Establish communication	No incidences.
	n protocols		to link	protocols in all levels: Use of	
	between		implements	ISOBUS or TCP/IP or other	
	implements		and	protocols to enable	
	and the		machinery	communication from the FC up	
	machinery		such that they	to the implement/UGV.	
	established		work	Count incidences where help of	
			together?	dealer / manufacturer is	
1				required to make the	

			<u>Timing: Once</u> for each implement.	implement and UGV work with the FC.	
31	Data retrieved from operations are properly displayed and understood	MET_TEC_F-C_06	End-users are able to find and understand the way the data is displayed. <u>Timing: One</u> <u>time per year</u> <u>with 5 users</u> <u>each time.</u>	Receive data from sensors: perception information from the field (examples: soil and weather conditions, 3D mapping of the field and the crops, GPS data for the position of the tractor, diesel level sensor, heat of engine sensor, remote supervision, camera data, etc.). Ask end-users a description of the information displayed. Ask them to find specific information (speed, position, progress of the mission etc.)	The farmer is able to find and understand the information that is displayed. The farmer is able to make decisions from the information displayed (ex: if the diesel levels are low, then he can refill, etc.).
32	Autonomous response of the robotic system to unforeseen events.	MET_TEC_F-C_09	Autonomy to respond to unforeseen events. <u>Timing:</u> <u>During a field</u> <u>operation – At</u> <u>least once a</u> <u>year.</u>	Place a heavy (+40kg min) container in the middle of the passageway, on a headland, make the FC believe that the wind is rising, that it is starting to rain: in all cases, record the reaction of the robotic system. Determine if the reaction of the robotic system is appropriate (it bypasses the obstacle without damaged plants or skipping work it could do; it stops its operation due to weather issues;) Number of not appropriate reaction.	System responses autonomously and successfully.
33	Input information of each UGV and implement in the FMIS.	MET_TEC_F-C_11	Ability to input information of each UGV and implement in the FMIS. <u>Timing: Once</u> for each robot <u>and</u> implement.	Store description of all robots and implements on the farm (include weight, size, working width, fuel autonomy, source of fuel, which connectors are available, etc.) Indicate the ability or non- ability. Define data size.	Yes.
34	Performance assessment visualisation.	MET_TEC_F-C_13	Efficiency of the user interface to visualize as- applied information and performance assessment.	End user feedback with a 1 to 4 scale (Nothing wrong, Efficient, Not efficient, Unusable).	At least "Efficient" to "Nothing wrong"

			Timing: Once		
35	User interface	MET_TEC_F-C_14	<u>a year.</u> Efficiency of	End user feedback with a 1 to 4	At least
33	inputs task-		the user	scale (Nothing wrong, Efficient,	"Efficient" to
	related		interface to	Not efficient, Unusable)	"Nothing
			input task-	Not enicient, onusable)	wrong"
	parameters		related		wrong
			parameters.		
			Timing: Once		
26			<u>a year.</u>		
36	Conditions to	MET_TEC_F-C_01	Ability to	Record if it is possible or not.	Yes, it is
	be met before		input the		possible
	execution of		conditions		
	tasks		under which a		
			task is		
			performed		
			into the		
			robotic		
			system.		
			<u>Timing:</u>		
			<u>Before</u>		
			starting fields		
			operations -		
			At least once		
			<u>per task</u>		
37	Resources for	MET_TEC_F-C_02	Ability to	Record if it is possible or not.	Yes, it is
	the execution		input the		possible
	of tasks		resources		
			available or		
			not for each		
			task.		
			<u>Timing:</u>		
			<u>Before</u>		
			starting fields		
			operations -		
			At least once		
			<u>per task</u>		
38	Constraints on	MET_TEC_F-C_03	Ability to	Record if it is possible or not.	Yes, it is
	when and		input time		possible
	how tasks		constrain for		
	should be		each task and		
	executed		to parameter		
			each task.		
			Timing:		
			<u>Before</u>		
			starting fields		
			operations -		
			At least once		
			per task		
39	Robot's	MET_TEC_F-C_04	Does the	Leave less fuel than the mission	>90%
	battery		farmer get a	needs in the tank of the UGV.	
	notification		notification	Start the mission and record, if	
			when the level	you are notified, whether you	
			of fuel is low	have time to stop the robot	
			and before it	before it stops by itself.	
			reaches 0?		
			reaches U!		

			T		1
			Timing:	[ = Number of times the robot is	
			Timing: Before	refilled before it runs out of	
			starting fields	power / Number of tests of this	
			operations -	measure]	
			At least once		
			<u>per task</u>		
40	Precision of	MET_TEC_F-C_05	Reality of the	Have a digital copy of the field	At least
	the digital		copy.	in a virtual environment	"Similar" to
	twin of the		<u>Timing:</u>	alongside with the CAD files of	"exactly the
	field		<u>Before</u>	the used resources. This digital	same"
			<u>starting</u>	copy should be precise.	
			weeding	End user feedback with a 1 to 5	
			<u>season and</u>	scale (Exactly the same, strong	
			after weeding	likeness, similar, some defect,	
			<u>season. At</u>	not a copy)	
			least twice per		
			<u>year</u>		
41	FMIS provides	MET_TEC_F-C_07	Communicatio	Change a parameter in the FMIS	Communicatio
	information		n between the	and record if it was changed in	n between the
	about the		FC and the	the FC.	FC and the
	needs of the		FMIS.		FMIS is
	crops		<u>Timing:</u>		achieved.
			<u>Before</u>		
			starting a field		
			operation - At		
			least twice per		
			weeding		
			<u>season.</u>		
42	Input task	MET_TEC_F-C_10	Ability to	Store all field operations with	Yes.
	information in		input	related information (e.g.,	
	the FMIS.				
	the Fivils.		information	technical, financial, etc.)	
	the Fivils.		on each task	Indicate if it is possible or not to	
			on each task in the FMIS.	-	
	the Fivils.		on each task in the FMIS. <u>Timing: Once</u>	Indicate if it is possible or not to	
			on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u>	Indicate if it is possible or not to	
			on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u>	Indicate if it is possible or not to	
			on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u>	Indicate if it is possible or not to	
			on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u>	Indicate if it is possible or not to do it.	
43	End-user's	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end-	Indicate if it is possible or not to do it. Record case where the end user	No cases
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	No cases occur.
43	End-user's	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time	Indicate if it is possible or not to do it. Record case where the end user	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require?	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u>	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u>	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u> <u>process - At</u>	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u> <u>process - At</u> <u>least twice per</u>	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to	MET_TEC_F-C_16	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u> <u>process - At</u>	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he	
43	End-user's ability to intervene		on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u> <u>process - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u>	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he would have done.	occur.
43	End-user's ability to intervene Ability to	MET_TEC_F-C_16 MET_TEC_F-C_17	on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u> <u>process - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he would have done. Record if the robotic system	occur. Both possible.
	End-user's ability to intervene		on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u> <u>process - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the operation be	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he would have done. Record if the robotic system can be paused during its	occur. Both possible. At least "ok"
	End-user's ability to intervene Ability to		on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u> <u>process - At</u> <u>least twice per</u> <u>weeding</u> <u>season.</u> Can the	Indicate if it is possible or not to do it. Record case where the end user cannot intervene and what s/he would have done. Record if the robotic system	occur. Both possible.

			Timin		
			Timing:	of this process: End user	
			Before	feedback of their control of the	
			starting the	robotic system with a 1 to 5	
			weeding	scale (very easy, easy, ok,	
			season.	difficult very difficult).	
			NON-TECHNICAL	KPIS	
45	Dete es suritu	MET NITEC and OD	Safety	Lies en eurort like e dete	00% unting a
45	Data security	MET_N-TEC_saf_03	Ensure that data cannot	Use an expert, like a data integrity expert, cloud security	99% uptime guaranteed of
				expert from one of the	the robot.
			be improperly accessed or	institutes to perform an	the robot.
			modified).	•	
				integrity test (From the land	
			Timing: Once	survey to the robotic mission	
			<u>a year.</u>	and data record by the robotic system in the field).	
46	Compliance	MET_N-TEC_saf_04	Check the list	Send list to robot supplier for	Robotic
40	with Machine		of standards	verification that the standards	companies are
	directive and		and	are harmonized.	in compliance
	the EU		regulations		with the
	legislations		collected in	Number of standards company	required
	registations		WP1 are	is in compliance/not in	standards so
			compliant	compliance.	the product
			with the		can be CE
			robotic		marked.
			system.		
			Timing: Once		
			a year.		
47	Injuries and	MET_N-TEC_saf_01	Injuries to	Record the number of injuries	Injures
	danger		human or	suffer by a human and the	≤2/season
	created by the		dangerous	number of injured humans.	Danger ≤ 2
	robot		situation	Record the number of	
			created by the	dangerous situation (users	
			robotic	perspective when/if they have	
			system.	felt that the robot was unsafe	
			Timing: All	or if the robot would hurt	
			along the	them) and their level (Minor=	
			process –	No consequences, Significant =	
			<u>when it</u>	Minor injuries / Minor damages	
			happens.	of other equipment / Minor	
				damage of public or private	
				property / Temporary damage	
				to environment, Critical =	
				Temporary disability without	
				death threat / Temporary	
				professional disease / Serious	
				injure / Loss or damaged of the	
				robotic system / Loss or big	
				damage of public or private	
				property / Long term damaged	
				to the environment ,	
				Catastrophic = Death / Death	
				threat / Permanent disability /	
				Professional diseases).	
				Injurge - number of injurge	
				Injures = number of injures	
L				× number of human injured	

			I		
				Danger=number of dangerous situation×level	
				of the situation (1 for	
				minor-2 for significant-3	
				for Critical-4 for	
40	Compliance		Casasukara	Catastrophic)	7
48	Compliance with local law	MET_N-TEC_saf_02	Cases where the robotic	Record case where the robotic system does not comply with	Zero cases.
	and regulation		system do not	the local law and regulation.	
	una regulation		comply with	Number of cases.	
			the local law		
			and		
			regulation.		
			Timing: All		
			along the		
			process –		
			when it		
40	Dessibility		happens.	Determine (fith - first)	Ablata
49	Possibility to	MET_N-TEC_saf_05	Can the final	Determine if the final user can	Able to
	monitor implement		user monitor parameters	monitor parameters of the robotic system as a tractor	monitor: <u>UGV</u> : Speed,
	and robot's		that drives the	driver can.	chaining of
	functions		implement	Indicate number of parameters	row, height of
			and the	not monitored.	the implement
			roboť s		etc.
			functioning as		Implement:
			a tractor		height of the
			driver can?		implement,
			Timing: All		adjustment
			along the		etc.
			process - At		
			<u>least twice</u> each year		
			Labour		
50	Ability to keep	MET_N-TEC_lab_06	Is the FMIS	End user feedback with a 1 to 4	At least
	inventory of		well construct	scale (Nothing wrong, Efficient,	"Efficient" to
	farm inputs		to keep the	Not efficient, Unusable)	"Nothing
			inventory of		wrong"
			goods?		
			Timing: Once		
F1	Canacity of		<u>a year</u>	End user feedback of their	End user
51	Capacity of the end-user	MET_N-TEC_lab_01	Capacity of an end-user to	control of the robotic system	feedback at
	to manage the		control the	with a 1 to 5 scale (very easy,	least "ok" to
	robotic		robotic	easy, ok, difficult very difficult)	"very easy"
	system		system with	and assessment by an	Experienced
			only a user's	experienced user of this control	user
			manual and a	(with the same 1 to 5 scale).	assessment at
			training.		least "ok" to
			Timing: At		"very easy"
			least once per		
52	Open road	MET_N-TEC_lab_03	<u>season.</u> Can the	Record if no.	All Yes.
-			robotic	If yes, evaluate the	Easy to Ok
	transport of		TODOLIC	II yes, evaluate the	
	transport of the robotic		system (UGV +	maneuverability of your route	assessment

					I
			on a trailer or within a van? <u>Timing: At</u> <u>least once per</u> <u>season</u>		
53	Use of conventional tools	MET_N-TEC_lab_04	The hardware can be maintained with conventional tools that the farmer uses. <u>Timing: All</u> <u>along the</u> <u>process – At</u> <u>each</u> <u>maintenance</u>	Indicate the tool needed to maintain the robot or the implement	No unconvention al tool is needed.
54	Feasibility of the workplan	MET_N-TEC_lab_05	Measure the feasibility of the workplan. <u>Timing: At</u> <u>least once per</u> <u>season</u>	End user feedback with a 1 to 5 scale (Perfect, Feasible easily, not that simple but feasible, Need few changes, Impossible)	At least "not that simple but feasible" to "Perfect".
			Ethics		
55	Additional health risk and/or need for additional insurance for the farmer	MET_N- TEC_Eth_03	<ul> <li>Is there is a need for an additional insurance?</li> <li>Risk to user's health and difficulty of work.</li> <li>Time invested in discussions with insurance companies.</li> <li>Timing: Before starting the field operations – when discussing with insurance companies.</li> </ul>	<ul> <li>The system should not invalidate the health insurance of the people using it (high-risk sports such as sky diving require additional insurance - we don't want this for the R4C robotic system).</li> <li>Is an additional insurance necessary?</li> <li>Record time invested in discussions with insurance companies.</li> <li>Record for each conventional and autonomous system: - Amounts and type of pesticides and herbicides used.</li> <li>Number of operations that may cause human exposure to pesticides</li> <li>Number of operations that have a lower health risk</li> <li>Number of operations that have a higher health risk</li> <li>Time of exposure: • To pesticides • To tractor vibration (with a conventional system)</li> <li>Hours of physical work (with both conventional and autonomous system)</li> </ul>	The use of the robot doesn't recommend a supplementar y health insurance.

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56	Liability	MET_N-	Presence of a	The system should not	The use of the
	insurance of	TEC_Eth_04	health	invalidate the liability insurance	robot doesn't
	the testing		insurance of	of the property on which the	recommend a
	property		the operator	R4C robotic system is used.	supplementar
			Time invested	Indicate presence/absence of	y health
			from the end	health insurance.	insurance.
			user to		
			convince the		
			insurance		
			company.		
			Timing:		
			Before		
			starting the		
			field		
			operations -		
			<u>when</u>		
			discussing		
			with insurance		
			companies.		
57	Farmer's	MET_N-	Possibility to	Farmer should be able to	Yes, the
	understanding	TEC_Eth_01	follow the FC	understand the decisions made	farmer is able.
	_		decision.	by the system.	
			Timing:	Record if it is possible and	
			Before	understandable or not.	
			starting a field		
			operation - At		
			least twice per		
			season		
58	Farmer's	MFT N-		Farmer should be able to	Yes the
58	Farmer's	MET_N-	Ability to	Farmer should be able to	Yes, the farmer is able
58	ability to	MET_N- TEC_Eth_02	Ability to manually	intervene in the decisions made	Yes, the farmer is able.
58	ability to intervene in	_	Ability to manually modified each	intervene in the decisions made by the system when needed.	
58	ability to intervene in the decision	_	Ability to manually modified each decision of	intervene in the decisions made	
58	ability to intervene in	_	Ability to manually modified each decision of the FC.	intervene in the decisions made by the system when needed.	
58	ability to intervene in the decision	_	Ability to manually modified each decision of the FC. <u>Timing:</u>	intervene in the decisions made by the system when needed.	
58	ability to intervene in the decision	_	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u>	intervene in the decisions made by the system when needed.	
58	ability to intervene in the decision	_	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u>	intervene in the decisions made by the system when needed.	
58	ability to intervene in the decision	_	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u>	intervene in the decisions made by the system when needed.	
58	ability to intervene in the decision	_	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u>	intervene in the decisions made by the system when needed.	
58	ability to intervene in the decision	_	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u>	intervene in the decisions made by the system when needed.	
	ability to intervene in the decision making	TEC_Eth_02	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u>	intervene in the decisions made by the system when needed. Record if it is possible or not.	farmer is able.
58	ability to intervene in the decision making Cost-	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to	intervene in the decisions made by the system when needed. Record if it is possible or not. <u>For both conventional and</u>	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness	TEC_Eth_02	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the	intervene in the decisions made by the system when needed. Record if it is possible or not. <u>For both conventional and</u> <u>autonomous system</u> :	farmer is able.
	ability to intervene in the decision making Cost-	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to	intervene in the decisions made by the system when needed. Record if it is possible or not. For both conventional and autonomous system: • Time between starting the	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the	intervene in the decisions made by the system when needed. Record if it is possible or not. <u>For both conventional and</u> <u>autonomous system</u> :	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic	intervene in the decisions made by the system when needed. Record if it is possible or not. For both conventional and autonomous system: • Time between starting the	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all	intervene in the decisions made by the system when needed. Record if it is possible or not.           For both conventional and autonomous system:           • Time between starting the motor and the implement	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects.	<ul> <li>intervene in the decisions made by the system when needed.</li> <li>Record if it is possible or not.</li> </ul> For both conventional and autonomous system: <ul> <li>Time between starting the motor and the implement coupling to the robot.</li> </ul>	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects. <u>Timing:</u>	<ul> <li>intervene in the decisions made by the system when needed.</li> <li>Record if it is possible or not.</li> <li>For both conventional and autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the</li> </ul>	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects.	intervene in the decisions made by the system when needed. Record if it is possible or not. For both conventional and autonomous system: • Time between starting the motor and the implement coupling to the robot. • Time between attaching the implements to the robot and the robot is attached on the	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2.	intervene in the decisions made by the system when needed. Record if it is possible or not. For both conventional and autonomous system: • Time between starting the motor and the implement coupling to the robot. • Time between attaching the implements to the robot and the robot is attached on the transport	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2. • All other	intervene in the decisions made by the system when needed. Record if it is possible or not. For both conventional and autonomous system: • Time between starting the motor and the implement coupling to the robot. • Time between attaching the implements to the robot and the robot is attached on the transport • Time from the moment the	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2. • All other metrics: Once	<ul> <li>intervene in the decisions made by the system when needed.</li> <li>Record if it is possible or not.</li> <li>For both conventional and autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to</li> </ul>	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2. • All other metrics: Once each year -	intervene in the decisions made by the system when needed. Record if it is possible or not. For both conventional and autonomous system: • Time between starting the motor and the implement coupling to the robot. • Time between attaching the implements to the robot and the robot is attached on the transport • Time from the moment the transport arrived at the field to the moment when the	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u>	intervene in the decisions made by the system when needed. Record if it is possible or not.	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u> <u>the minimum</u>	intervene in the decisions made by the system when needed. Record if it is possible or not. For both conventional and autonomous system: • Time between starting the motor and the implement coupling to the robot. • Time between attaching the implements to the robot and the robot is attached on the transport • Time from the moment the transport arrived at the field to the moment when the	farmer is able. Be cost
	ability to intervene in the decision making Cost- effectiveness of the robotic	TEC_Eth_02 MET_N-	Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u> <u>Economics</u> User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u>	intervene in the decisions made by the system when needed. Record if it is possible or not.	farmer is able. Be cost

			1
		<ul> <li>How many field operations</li> </ul>	
		are necessary to have a clean	
		plot?	
		• Fuel consumption per hectare	
		<ul> <li>Quantity of pesticide and</li> </ul>	
		herbicides used	
		• Type of pesticide and	
		herbicides used	
		• Yield	
		Cost of: - Herbicide – Fertilizer	
		<ul> <li>Plant protection products -</li> </ul>	
		Fuel – Harvest	
		<ul> <li>Fixed costs</li> </ul>	
		Investments	
		<ul> <li>Lifetime of investments</li> </ul>	
		Current interest rate	
		Number of operations	
		-	
		Total spending per hectare	
		with robotic system	
		Total spending per hectare	
		with conventional system	
		<ul> <li>Number of hectares that the</li> </ul>	
		robotic system can handle	
		<ul> <li>Number of hectares of the</li> </ul>	
		farm	
		Data about the region:	
		• Total Area (ha)	
		Geographical relevance and     boundaries (a.g., Covered by	
		boundaries (e.g., Covered by	
		cooperatives, local region,	
		catchment)	
		<ul> <li>Number of farms within the</li> </ul>	
		area, type of farmland (soil	
		type), crops produced, farm	
		sizes and structure, employees	
		Number of citizens	
		<ul> <li>Data of ~100 Farmer:</li> </ul>	
		education, age, farm size and	
		type of farm and crops	
		produced, questions about	
		farmers perception of various	
		autonomous systems, needs,	
		barriers, technical problems,	
		-	
		speed, risk, skills, convenience	
		• Assess the number of jobs	
		that could be created in relation	
		to Agri-and IT business	
		Analysis:	
		• Time of the end user allocated	
		for the task (weeding or	
		spraying)	
		• Cost per hectare of the task	
	Social		

60	Social	-	Measure the	End-user feedback. The robotic	Acceptable or
	acceptance		social	solution is: Not acceptable (no	highly
			acceptance of	useful outcome, easiness to	acceptable.
			the proposed	use, or benefit) – Acceptable	
			robotic	(some benefit) - Highly	
			solution.	acceptable (end-user identifies	
			Timing: Once	high benefit from the use of the	
			<u>at the end of</u>	robot)	
			<u>each year -</u>		
			Validation of		
			<u>the minimum</u>		
			<u>viable</u>		
			product.		

#### 2.2.2 LSP 2 - Greece - KPIs

Below, the KPIs for LSP 2 are presented.

#### Table 2 KPIs for the evaluation of LSP 2

			AGRONOMIC K	Pls	
KPI	KPI title	Related measurable metric from WP1 (D1.4)	Measurement	Description	Target
1	Plant damage/ destruction	MET_AGRO_1	Number of damaged or destroyed plants that are not predisposed to be wounded. <u>Timing: at</u> <u>least 2</u> <u>times/year</u>	Throughout the spraying season, analyse one-hectare equivalent of vine by following the UGV on different rows and record the number of damaged plants (broken cane, bunch of grapes damaged or destroyed) or destroyed plants (trunk cleaved or uprooted). If a damaged or destroyed plant is detected, record the origin of the damage: cuttings poorly attached to their stakes, not straight row, implements badly adjust (too strong), robotic guidance or other origin. <u>Crop damage % and crop</u> <u>destruction % related to</u> : -crop management (=cuttings poorly attached to their stakes and not straight row), -UGV guidance law, - Implement adjustment, - Other issues.	<10% in total (robotic system or other reason)
2	Agronomic performance of the robot	MET_AGRO_3	Agronomic satisfaction of the robotic system work <u>Timing: After</u> <u>each field</u> <u>operation</u>	End user or Ecosystem chair feedback with a 1 to 5 scale (very good, good, ok, bad, very bad).	At least feedback between "Ok" to "very good"
			TECHNICAL KP	···	
		Unmai	nned Ground Veh	icle (UGV)	

					,
3	Size of robot suitable for different crops	MET_TEC_UGV_05 b	Is the size of the robotic system suitable to the crop? <u>Timing: At the</u> <u>development</u> <u>phase</u>	Robot should be suitable to all vegetables (Sugar beets, pumpkin, onions, broccoli, lettuce etc.), vineyards and orchards. Record width between the rows of vine and the height where the robotic system cannot pass.	Common row spacing (1,40 cm to 3 m) Crop height and surrounding (pole, net) should match the UGV height.
4	Hardware present and operational	MET_TEC_UGV_17	Hardware is present and works on robot. Is there hardware for data transmission, for GNSS positioning, for mobile connection to the cloud? <u>Timing: At the</u> <u>development</u> <u>phase</u>	UGV is equipped with a connectivity system for data transmission, GNSS positioning, mobile connection to the cloud	Yes. Robot can operate successfully. Comment.
5	Electrical, hydraulic and PTO output to the implement	MET_TEC_UGV_20	Hardware is present and works on robot. <u>Timing: At the</u> <u>development</u> <u>phase</u>	The robotic platform should provide electrical, hydraulic and PTO output to the implement. Is there hardware to provide electrical, hydraulic and PTO output to the implement?	Robot can operate successfully with the implement.
6	Robotics platform regroups the data to communicate with the user	MET_TEC_UGV_22	GUI communicatin g information needed. <u>Timing: At the</u> <u>development</u> <u>phase</u>	Record all types of messages the robotic platform communicates. Confirmation that hard/software is available and functional.	The robot operator is able to receive the data s/he needs to make decisions and supervise.
7	3-point hitch	MET_TEC_UGV_07	Is the UGV equipped with an equivalent to a 3-point hitch. Does it have a 3-point hitch (ISO730, CAT I, II, or III)? <b>Timing:</b> At least once during the project (Before treatment season).	Do the implements and UGVs follow the same Cat or standard for the 3-point hitch dimensions and lifting capacity. Record the UGV 3-point hitch dimensions Record the 3-point hitch of the implement	Yes

			[ ·		[
8	AB lines import from GNSS system	MET_TEC_UGV_24	The AB lines are moved from a shape file to the robot management/ planning software. <u>Timing: When</u> <u>creating a new</u> <u>path planning</u>	Are AB lines displayed correctly in the robot management software? Ensure that AB lines from commercial systems in use in 2021 can be imported into the robotic system through FMIS and Farming controller interfaces.	No need for AB line setup should be necessary on the field robot itself.
9	Performing in wet clay soil	MET_TEC_UGV_12	Ability to perform a mission with implements in the limits of the robotic systems. <u>Timing:</u> <u>After the</u> <u>weeding</u> <u>season - At</u> <u>least once per</u> <u>year</u>	Use the heavier tool of the Large-Scale Pilot (up to 400 kg) and record the level of easiness of the robot to handle it in a wet clay soil (Very Easy - Easy - Suitable - Hard - Very hard)	At least "Suitable" to "Very Easy" assessment.
10	Autonomy of the whole robotic system	MET_TEC_UGV_04	The robot should have an autonomy of minimum 8 -10 hours. <u>Timing:</u> <u>During a</u> <u>specific test –</u> <u>once a year</u>	Let the robot run in a loop until it stops, and record time during the operation.	Time > 8hours
11	Teach in	MET_TEC_UGV_25	Precision of teach in and efficiency <u>Timing: Once</u> <u>a year after all</u> <u>field</u> <u>operation</u>	Teach in: Driving routes can be taught, including patterns of AB lines and connecting headland turns. Deviation of the teach in. End user feedback with a 1 to 4 scale (Very efficient, Efficient, Not efficient, Unusable)	Deviation < 5cm Feedback at least Efficient
12	Human intervention in robotic work	MET_TEC_UGV_01	Cases where the robotic system cannot work without human assistance <u>Timing:</u> <u>During field</u> <u>operations</u>	Record a description of the intervention and the time allocated to it. Record the total time used by the end user for the whole weeding operation. Determine the % of intervention time in relation to total time.	<10% intervention time
13	Farmer competences for using the robot	MET_TEC_UGV_01	Competences required for farm workers, using robotic systems for	Record the number of operations consider as harder than driving a tractor and the competences required to achieve them.	>10% easier operations

				Descend the average of	]
			repetitive work <u>Timing: At the</u> <u>end of each</u> <u>spraying</u> <u>season</u>	Record the number of operations consider as easier than driving a tractor and the competences required to achieve them.	
14	Deviation of the trajectory of the towing system.	MET_TEC_UGV_02	Deviation of the trajectory of the towing system. <u>Timing: After</u> <u>each</u> <u>operation</u>	Record the time of entry and the time of exit of 3 straight rows of the UGV. Record the speed of the UGV in those rows. Retrieve log of the UGV.	Percentage of deviation from the planned trajectory between 50 and 100 mm: <10% Percentage of deviation from the planned trajectory above 100 mm: <2%
15	Capacity of robot and tractor to work under different conditions	MET_TEC_UGV_05	Condition where a robot couldn't work and where a tractor could. <u>Timing: After</u> <u>field</u> <u>operation –</u> <u>when it</u> <u>happens</u>	In practice, mechanical weeding or spraying can only be done under certain conditions (weather, state of the soil (e.g., moisture level), and growth stages of both the crop and the weeds), the robot must be able to work at least in those conditions where a tractor could pass. Record all situations where a robot couldn't work and where a tractor could. Define the expected work. Record all operation of the field. Determine the % of operations carried out by a robot.	50% of tractor-based operations are carried out autonomously
16	Equipment breakdown. Reliability of the UGV.	MET_TEC_UGV_09	Number and Importance of the breakdown. Ability to repair. <u>Timing: All</u> <u>along the</u> <u>process –</u> <u>when it</u> <u>happens</u>	Record all breakdown (hardware or software) and record the time needed to repair and if help from the constructor was needed. Record if the issue is documented. Determine: Number and % of small breakdown: less than 1h of repairs and no need of help from constructor. Number and % of medium breakdown: less than 2 hours of repairs or help of the constructors Number and % of serious breakdown: more than 2 hours of repairs.	90% of all mechanical breakdowns are documented or can be repaired by a user equipped for mechanical interventions by season. 2 small breakdown max per month. 2 medium breakdown max per season.

					2 serious breakdown max per 10 years.
17	UGV works in low temperatures	MET_TEC_UGV_10	UGV Performing a mission in low temperatures <u>Timing:</u> <u>During fields</u> <u>operations –</u> <u>for each</u> <u>operation</u>	Record the temperature min of the environment when the robot was used without issues link to temperature.	Be able to work at low temperatures (-5°C).
18	UGV works in high temperatures	MET_TEC_UGV_11	UGV Performing a mission in high temperatures <u>Timing:</u> <u>During fields</u> <u>operations –</u> for each <u>operation</u>	Record the temperature min of the environment when the robot was used without issues link to temperature.	Be able to work in high heat (+40°C).
19	Improvement of guidance and U-turn of the UGV	MET_TEC_UGV_14	Areas for improvement of guidance and U-turn of the UGV <u>Timing:</u> <u>During fields</u> <u>operations –</u> <u>when it</u> <u>happens</u>	Record any movement that the robot does not do the way the farmer wants. Rate their importance: End user feedback with an 1 to 3 scale (Efficient, Not efficient, Unusable). Determine the number of "Unusable" comments.	Efficient. If not, optimize the path planning and reduce pass overs and soil compaction.
20	Level of system deterioration due to weather	MET_TEC_UGV_16	Does the weather significantly deteriorate the system? <u>Timing:</u> <u>During fields</u> <u>operations –</u> <u>when it</u> <u>happens</u>	The robot should be robust with an IP similar to tractors (IP 65-67). Record breakdown caused by the weather. Determine repetitive breakdowns of one component due to weather.	All robotic components are Robust (IP 65-67) or protected to have a similar robustness.
21	Trajectory optimisation/ Reduction of pass overs	MET_TEC_UGV_19	Number of pass overs. <u>Timing:</u> <u>During fields</u> <u>operations -</u> <u>At least twice</u> <u>per spraying</u> <u>season</u>	Record the number of pass overs during each operation.	< 2 pass overs
22	Correct calculation of the tank reserve	MET_TEC_UGV_21	Correct calculation of the tank reserve.	Does the Robotic system detect an empty tank during an operation? Is the tank empty?	Yes

					1
			<u>Timing:</u>		
			During fields		
			operations -		
			At least twice		
			per spraying		
			season Implements		
23	Implement's	MET_TEC_IMP_06	Is the	CAN bus/ISOBUS compatibility.	ISOBUS based
23	ISOBUS		Communicatio	CAN busy isobos compatibility.	communicatio
	compatibility		n between		n within the
	compationity		ECUs		implement-
			(Electronics		vehicle
			Control Unit)		combination
			of vehicle and		operate
			implement		successfully.
			defined?		successfully.
			Timing: At the		
			development		
			phase		
24	Speed of the	MET_TEC_IMP_01	Speed of the	Tow implements that need a	speed
	UGV		UGV.	speed between 2km/h to 8	difference
			Timing: After	km/h.	<1km/h
			each field	Record speed use for each	,
			operation	implement.	
				Record speed expectation for	
				this tool.	
				Record speed instruction	
				(speed set in the path planning	
				instructions).	
				[speed difference for each tool=	
				speed expectation- speed use]	
25	Spraying	MET_TEC_IMP_03	Is spraying	Place papers above 3 leaves,	Above leaves:
	coverage		homogeneous	under 3 leaves, 3 in the alley, 3	100%
			in all the	in a row, 3 just out of the field.	Under leaves:
			canopy?	Spray with the robot. Check and	80%?
			Timing:	record which paper are wet	In the alley:
			Before and	which are not.	<5%
			After each		Out of the
			<u>field</u>	= Number of paper of one	field: 0%
			operation - At	type wet / Total number of	
			least twice per	papers	
26	Detection of		<u>season</u> Record of	Record each nozzle obstruction.	95% of nozzle
20	nozzle	MET_TEC_IMP_04	nozzle	Record each nozzle obstruction. Record if the robotic system has	obstruction
	obstruction		obstruction.	detected it or not. Determine	detected.
	obstruction		Timing: After	the % of not detected nozzle	
			each field	obstruction.	
			operation –		
			when it		
			happens		
27	Automated	MET_TEC_IMP_05	Is the tank	End user and technician	≤2
	cleaning and		well cleaned?	feedback with a 1 to 5 scale	
	maintenance		Is the	(very good, good, ok, bad, very	
			maintenance	bad)	
			of the sprayer		
			enough?		
				i	

			Timing: After		
			spraying		
			operations -		
			At least twice		
			<u>per season</u>		
28 Im	nplement	MET_TEC_IMP_08	Consumption	Record situations where the	Robotic
со	ommunicatio		of supply	robotic system can optimize its	system can
n	with robotic		sources.	consumption (energy or	optimize its
pla	atform /		Timing:	consumable).	consumption.
ac	ctivating		During field		
	apply sources		operation - At		
			least twice per		
			season		
<b>29</b> Pr	roduction of	MET_TEC_IMP_10	Recording the	Acquisition of as-applied	To represent
	OXML files		as-applied	amount (Sprayer) together with	the behaviour
	be sent to		information of	geo-location of applied points.	of the
	ne FMIS		field	geo-location of applied points.	implements
					-
			application		during field
			and producing		application.
			ISOXML file		
			available on		
			the ISOBUS		
			terminal.		
			<u>Timing:</u>		
			During each		
			<u>field</u>		
			application		
<b>30</b> Fu	ull load tank	MET_TEC_IMP_11	Full load a	The user can fill the tank of the	Autonomy of
au	utonomy		tank. Record	sprayer during a mission to a	60 min
			the time taken	full-load tank autonomy of 60	minimum
			for it to empty	min.	
			during		
			autonomous		
			operations.		
			Timing:		
			During a		
			spraying		
			operation - At		
			least twice per		
			weeding		
			season		
		Far	ming Controller &	2 FMIS	
<b>31</b> Pr	resentation	MET_TEC_F-C_15	Virtual map of	Is there a virtual map of the	Presence of a
-	fgeospatial		the plot.	plot?	virtual map of
	ata		Timing: At the	piot:	the plot
da	ata				-
			development		usable during
			<u>phase.</u>		the operation
					for the end-
					user.
	ommunicatio	MET_TEC_F-C_08	Is it possible	Establish communication	No incidences.
-	protocols		to link	protocols in all levels: Use of	
be	etween		implements	ISOBUS or TCP/IP or other	
	nplements		and	protocols to enable	
im	piements				
	nd the		machinery	communication from the FC up	
an	-		machinery such that they	communication from the FC up to the implement/UGV.	

		[			,
			work together? <u>Timing: Once</u> <u>for each</u> <u>implement.</u>	Count incidences where help of dealer / manufacturer is required to make the implement and UGV work with the FC.	
33	Data retrieved from operations are properly displayed and understood	MET_TEC_F-C_06	End-users are able to find and understand the way the data is displayed. <u>Timing: One</u> <u>time per year</u> <u>with 5 users</u> <u>each time.</u>	Receive data from sensors: perception information from the field (examples: soil and weather conditions, 3D mapping of the field and the crops, GPS data for the position of the tractor, diesel level sensor, heat of engine sensor, remote supervision, camera data, etc.). Ask end-users a description of the information displayed. Ask them to find specific information (speed, position, progress of the mission etc.)	The farmer is able to find and understand the information that is displayed. The farmer is able to make decisions from the information displayed (ex: if the diesel levels are low, then he can refill, etc.).
34	Input information of each UGV and implement in the FMIS.	MET_TEC_F-C_11	Ability to input information of each UGV and implement in the FMIS. <u>Timing: Once</u> <u>for each robot</u> <u>and</u> implement.	Store description of all robots and implements on the farm (include weight, size, working width, fuel autonomy, source of fuel, which connectors are available, etc.) Indicate the ability or non- ability. Define data size.	Yes.
35	Prescription map for field operation	MET_TEC_F-C_12	Is the FMIS well construct to create a prescription map for field operation? <u>Timing: Once</u> <u>a year.</u>	End user feedback with a 1 to 4 scale (Nothing wrong, Efficient, Not efficient, Unusable)	At least "Efficient" to "Nothing wrong",
36	Performance assessment visualisation.	MET_TEC_F-C_13	Efficiency of the user interface to visualize as- applied information and performance assessment. <u>Timing: Once</u> <u>a year.</u>	End user feedback with a 1 to 4 scale (Nothing wrong, Efficient, Not efficient, Unusable).	At least "Efficient" to "Nothing wrong"
37	User interface inputs task- related parameters	MET_TEC_F-C_14	Efficiency of the user interface to input task-	End user feedback with a 1 to 4 scale (Nothing wrong, Efficient, Not efficient, Unusable)	At least "Efficient" to "Nothing wrong"

					1
			related		
			parameters.		
			Timing: Once		
			<u>a year.</u>		
38	Conditions to	MET_TEC_F-C_01	Ability to	Record if it is possible or not.	Yes, it is
	be met before		input the		possible
	execution of		conditions		
	tasks		under which a		
			task is		
			performed		
			into the		
			robotic		
			system.		
			Timing:		
			Before		
			starting fields		
			operations -		
			At least once		
			per task		
39	Resources for	MET_TEC_F-C_02	Ability to	Record if it is possible or not.	Yes, it is
35	the execution		input the		possible
	of tasks		resources		possible
	01 (03K5		available or		
			not for each		
			task.		
			Timing:		
			Before		
			starting fields		
			operations -		
			At least once		
			per task		
40	Constraints on	MET_TEC_F-C_03	Ability to	Record if it is possible or not.	Yes, it is
	when and		input time		possible
	how tasks		constrain for		
	should be		each task and		
	executed		to parameter		
			each task.		
			Timing:		
			<u>Before</u>		
			starting fields		
			operations -		
			At least once		
			<u>per task</u>		
41	Robot's	MET_TEC_F-C_04	Does the	Leave less fuel than the mission	>90%
	battery		farmer get a	needs in the tank of the UGV.	
	notification		notification	Start the mission and record, if	
			when the level	you are notified, whether you	
			of fuel is low	have time to stop the robot	
			and before it	before it stops by itself.	
			reaches 0?		
			Timing:	[ = Number of times the robot is	
			During a field	refilled before it runs out of	
			operation - At	power / Number of tests of this	
			least twice per	measure]	
			weeding		
			season		
		l	3003011		

42	Precision of	MET_TEC_F-C_05	Reality of the	Have a digital copy of the field	At least
	the digital		copy.	in a virtual environment	"Similar" to
	twin of the		Timing:	alongside with the CAD files of	"exactly the
	field		<u>Before</u>	the used resources. This digital	same"
			starting and	copy should be precise.	
			after spraying	End user feedback with a 1 to 5	
			<u>season. At</u>	scale (Exactly the same, strong	
			least twice per	likeness, similar, some defect,	
			<u>year</u>	not a copy)	
43	FMIS provides	MET_TEC_F-C_07	Communicatio	Change a parameter in the FMIS	Communicatio
	information		n between the	and record if it was changed in	n between the
	about the		FC and the	the FC.	FC and the
	needs of the		FMIS.		FMIS is
	crops		Timing:		achieved.
			Before		
			starting a field		
			operation - At		
			least twice per		
			season.		
44	Input task	MET TEC F-C 10	Ability to	Store all field operations with	Yes.
	information in		input	related information (e.g.,	
	the FMIS.		information	technical, financial, etc.)	
			on each task	Indicate if it is possible or not to	
			in the FMIS.	do it.	
			Timing: Once		
			<u>a year - At</u>		
			least twice per		
			season.		
45	End-user's	MET_TEC_F-C_16	Can the end-	Record case where the end user	No cases
	ability to		user intervene	cannot intervene and what s/he	occur.
	intervene		at any time	would have done.	
			during an		
			operation if		
			the		
			circumstances		
			so require?		
			Timing: All		
			along the		
			process - At		
			least twice per		
			season.		
46	Ability to	MET_TEC_F-C_17	Can the	Record if the robotic system	Both possible.
40	pause and		operation be	can be paused during its	At least "ok"
	resume tasks.		paused and	operation. Record if it can be	to "very easy".
	resume tasks.		resumed?	resumed. Record the easiness	to very casy.
			Timing:	of this process: End user	
			Before	feedback of their control of the	
			starting the	robotic system with a 1 to 5	
				scale (very easy, easy, ok,	
			<u>season.</u>	difficult very difficult).	
			NON-TECHNICAL		
			Safety		
47	Data security	MET_N-TEC_saf_03	Ensure that	Use an expert, like a data	99% uptime
			data cannot	integrity expert, cloud security	guaranteed of
				expert from one of the	the robot.
			viredorgmi ed		life lobol.
			be improperly	institutes to perform an	the robot.

		[		· · · ·	1
			accessed or modified). <u>Timing: Once</u> <u>a year.</u>	integrity test (From the land survey to the robotic mission and data record by the robotic system in the field).	
48	Compliance with Machine directive and the EU legislations	MET_N-TEC_saf_04	Check the list of standards and regulations collected in WP1 are compliant with the robotic system. <u>Timing: Once</u> <u>a year.</u>	Send list to robot supplier for verification that the standards are harmonized. Number of standards company is in compliance/not in compliance.	Robotic companies are in compliance with the required standards so the product can be CE marked.
49	Injuries and danger created by the robot	MET_N-TEC_saf_01	Injuries to human or dangerous situation created by the robotic system. <u>Timing: All</u> <u>along the</u> <u>process –</u> <u>when it</u> <u>happens.</u>	Record the number of injuries suffer by a human and the number of injured humans. Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt them) and their level (Minor= No consequences, Significant = Minor injuries / Minor damages of other equipment / Minor damage of public or private property / Temporary damage to environment, Critical = Temporary disability without death threat / Temporary professional disease / Serious injure / Loss or damaged of the robotic system / Loss or big damage of public or private property / Long term damaged to the environment , Catastrophic = Death / Death threat / Permanent disability / Professional diseases). <i>Injures = number of injures</i> × number of human injured Danger=number of dangerous situation×level of the situation (1 for minor-2 for significant-3 for Critical-4 for Catastrophic)	Injures ≤2/season Danger ≤ 2
50	Compliance with local law and regulation	MET_N-TEC_saf_02	Cases where the robotic system do not	Record case where the robotic system does not comply with the local law and regulation.	Zero cases.
			comply with the local law	Number of cases.	

		[			
			and		
			regulation.		
			Timing: All		
			along the		
			process –		
			when it		
			happens.		
			Labour		
51	Ability to keep	MET_N-TEC_lab_06	Is the FMIS	End user feedback with a 1 to 4	At least
51	inventory of		well construct	scale (Nothing wrong, Efficient,	"Efficient" to
	farm inputs		to keep the	Not efficient, Unusable)	"Nothing
	iann inputs		-	Not efficient, offusable)	wrong"
			inventory of		wrong
			goods?		
			Timing: Once		
	-		<u>a year</u>		-
52	Capacity of	MET_N-TEC_lab_01	Capacity of an	End user feedback of their	End user
	the end-user		end-user to	control of the robotic system	feedback at
	to manage the		control the	with a 1 to 5 scale (very easy,	least "ok" to
	robotic		robotic	easy, ok, difficult very difficult)	"very easy"
	system		system with	and assessment by an	Experienced
			only a user's	experienced user of this control	user
			manual and a	(with the same 1 to 5 scale).	assessment at
			training.		least "ok" to
			Timing: At		"very easy"
			least once per		
			season.		
53	Launching a	MET_N-TEC_lab_02	Time needed	Operational treatment: the	<31minutes
	mission in		to launch a	robot and the spraying system	
	field		mission in	should be quick to install and	
			field.	start spraying in cases of	
			Timing:	emergency spraying and in the	
			Before	available opportunity windows.	
			starting a field	<ul> <li>Record time between starting</li> </ul>	
			<u>operation –</u>	the motor and the implement	
				coupling to the robot.	
			<u>when it</u>		
			happens At	Record time between	
			least once per	attaching the implements to	
			<u>season.</u>	the robot and the robot is	
				attached on the transport.	
				Record time from the	
				moment the transport arrived	
				at the field to the moment the	
				robot starts its mission.	
				Sum of each time.	
54	Open road	MET_N-TEC_lab_03	Can the	Record if no.	All Yes.
	transport of		robotic	If yes, evaluate the	Easy to Ok
	the robotic		system (UGV +	maneuverability of your route	assessment
	system		Tools) be load	(Easy - Ok - Hard).	
			on a trailer or		
			within a van?		
			Timing: At		
			least once per		
			season		
55	Use of	MET_N-TEC_lab_04	The hardware	Indicate the tool needed to	No
					-
	conventional		can be	maintain the robot or the	unconvention
	conventional tools		can be maintained	maintain the robot or the implement	unconvention

			with		al tool is
			conventional		needed.
			tools that the		
			farmer uses.		
			Timing: All		
			along the		
			process – At		
			each		
			<u>maintenance</u>		
56	Feasibility of	MET_N-TEC_lab_05	Measure the	End user feedback with a 1 to 5	At least "not
	the workplan		feasibility of	scale (Perfect, Feasible easily,	that simple
			the workplan.	not that simple but feasible,	but feasible"
			Timing: At	Need few changes, Impossible)	to "Perfect".
			least once per		
			season		
		I	Ethics		I
57	Additional	MET_N-	<ul> <li>Is there is a</li> </ul>	The system should not	The use of the
57	health risk	_		invalidate the health insurance	robot doesn't
		TEC_Eth_03	need for an		
	and/or need		additional	of the people using it (high-risk	recommend a
	for additional		insurance?	sports such as sky diving require	supplementar
	insurance for		<ul> <li>Risk to user's</li> </ul>	additional insurance - we don't	y health
	the farmer		health and	want this for the R4C robotic	insurance.
			difficulty of	system).	
			work.	<ul> <li>Is an additional insurance</li> </ul>	
			• Time invested	necessary?	
			in discussions	Record time invested in	
			with	discussions with insurance	
			insurance	companies.	
			companies.	Record for each conventional	
				and autonomous system: -	
			Timing:	Amounts and type of	
			<u>Before</u>	pesticides and herbicides	
			starting the	used.	
			field	- Number of operations that	
			operations –	may cause human exposure	
			when	to pesticides	
			discussing	- Number of operations that	
				have a lower health risk	
			with insurance		
			companies.	- Number of operations that	
			<u>After each</u>	have a higher health risk	
			<u>season.</u>	- Time of exposure: • To	
				pesticides • To tractor	
				vibration (with a	
				conventional system)	
				- Hours of physical work (with	
				both conventional and	
				autonomous system)	
58	Liability	MET_N-	Presence of a	The system should not	The use of the
55	insurance of	TEC_Eth_04	health	invalidate the liability insurance	robot doesn't
				-	
	the testing		insurance of	of the property on which the	recommend a
	property		the operator	R4C robotic system is used.	supplementar
			Time invested	Indicate presence/absence of	y health
			from the end	health insurance.	insurance.
			user to		
			convince the		
1				1	1

					1
			insurance		
			company.		
			<u>Timing:</u>		
			<u>Before</u>		
			starting the		
			<u>field</u>		
			operations -		
			when		
			discussing		
			with insurance		
			companies.		
59	Farmer's	MET_N-	Possibility to	Farmer should be able to	Yes, the
	understanding	TEC_Eth_01	follow the FC	understand the decisions made	farmer is able.
	understanding	120_201_01	decision.	by the system.	iumer is usie.
			Timing:	Record if it is possible and	
			Before	understandable or not.	
			starting a field	understandable of not.	
			operation - At		
			-		
			least twice per		
60	Formaria		<u>season</u>	Formor chould be able to	Voc the
60	Farmer's	MET_N-	Ability to	Farmer should be able to intervene in the decisions made	Yes, the farmer is able.
	ability to	TEC_Eth_02	manually		farmer is able.
	intervene in		modified each	by the system when needed.	
	the decision		decision of	Record if it is possible or not.	
	making		the FC.		
			Timing:		
			<u>Before</u>		
			starting a field		
			operation - At		
			least twice per		
			season		
			<u>season</u> Economics		
61	Cost-	MET_N-	season Economics User time to	For both conventional and	Be cost
61	effectiveness	MET_N- TEC_eco_01	season Economics User time to prepare the	autonomous system:	Be cost effective.
61			season Economics User time to prepare the robotic		
61	effectiveness		season Economics User time to prepare the	autonomous system:	
61	effectiveness of the robotic		season Economics User time to prepare the robotic	autonomous system: • Time between starting the motor and the implement coupling to the robot.	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all	autonomous system: • Time between starting the motor and the implement	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic	autonomous system: • Time between starting the motor and the implement coupling to the robot.	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects.	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing:	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2.	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2. • All other	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year -	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - Validation of	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - Validation of the minimum	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u> the minimum viable	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> <li>How many field operations</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - Validation of the minimum	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> <li>How many field operations are necessary to have a clean</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u> the minimum viable	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> <li>How many field operations are necessary to have a clean plot?</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u> the minimum viable	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> <li>How many field operations are necessary to have a clean plot?</li> <li>Fuel consumption per hectare</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u> the minimum viable	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> <li>How many field operations are necessary to have a clean plot?</li> <li>Fuel consumption per hectare</li> <li>Quantity of pesticide and</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u> the minimum viable	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> <li>How many field operations are necessary to have a clean plot?</li> <li>Fuel consumption per hectare</li> <li>Quantity of pesticide and herbicides used</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u> the minimum viable	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> <li>How many field operations are necessary to have a clean plot?</li> <li>Fuel consumption per hectare</li> <li>Quantity of pesticide and herbicides used</li> <li>Type of pesticide and</li> </ul>	
61	effectiveness of the robotic		season Economics User time to prepare the robotic system and all economic aspects. Timing: • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of</u> the minimum viable	<ul> <li>autonomous system:</li> <li>Time between starting the motor and the implement coupling to the robot.</li> <li>Time between attaching the implements to the robot and the robot is attached on the transport</li> <li>Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot</li> <li>Cost of the Land Survey</li> <li>How many field operations are necessary to have a clean plot?</li> <li>Fuel consumption per hectare</li> <li>Quantity of pesticide and herbicides used</li> </ul>	

	acceptance		300101	solution is: Not acceptable (no	highly
62	Social	-	Measure the social	End-user feedback. The robotic	Acceptable or
			Social		
				Cost per hectare of the task	
				spraying)	
				for the task (weeding or	
				• Time of the end user allocated	
				Analysis:	
				to Agri-and IT business	
				that could be created in relation	
				• Assess the number of jobs	
				speed, risk, skills, convenience	
				barriers, technical problems,	
				autonomous systems, needs,	
				farmers perception of various	
				produced, questions about	
				type of farm and crops	
				<ul> <li>Data of ~100 Farmer: education, age, farm size and</li> </ul>	
				<ul> <li>Number of citizens</li> <li>Data of ~100 Farmer;</li> </ul>	
				sizes and structure, employees	
				type), crops produced, farm	
				area, type of farmland (soil	
				Number of farms within the	
				catchment)	
				cooperatives, local region,	
				<ul> <li>Geographical relevance and boundaries (e.g., Covered by</li> </ul>	
				Total Area (ha)     Coographical relevance and	
				Data about the region:	
				_	
				farm	
				• Number of hectares of the	
				robotic system can handle	
				Number of hectares that the	
				<ul> <li>Total spending per hectare with conventional system</li> </ul>	
				with robotic system	
				Total spending per hectare	
				Number of operations	
				<ul> <li>Current interest rate</li> </ul>	
				<ul> <li>Lifetime of investments</li> </ul>	
				• Investments	
				• Fixed costs	
				<ul> <li>Plant protection products -</li> <li>Fuel – Harvest</li> </ul>	
				Cost of: - Herbicide – Fertilizer	

	<u>the minimum</u> <u>viable</u> product.	
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#### 2.2.3 LSP 3 – Spain - KPIs

Below, the KPIs for LSP 3 are presented.

#### Table 3 KPIs for the evaluation of LSP 1

	Related						
КРІ	KPI title	measurable metric from WP1 (D1.4)	Measurement	Description	Target		
1	Plant damage/ destruction	MET_AGRO_1	Number of damaged or destroyed plants that are not predisposed to be wounded. <u>Timing: at</u> <u>least 2</u> <u>times/year</u>	Throughout the spraying season, analyse one-hectare equivalent of trees by following the UGV on different rows and record the number of damaged trees (broken branch, apple damaged or destroyed) or destroyed tree (trunk damaged). If a damaged or destroyed tree is detected, record the origin of the damage: implements badly adjusted (too strong), robotic guidance or other origin. <u>Crop damage % and crop</u> <u>destruction % related to</u> : -crop management (=cuttings poorly attached to their stakes and not straight row), -UGV guidance law, - Implement adjustment, - Other issues.	<10% in total (robotic system or other reason)		
2	Agronomic performance of the robot	MET_AGRO_3	Agronomic satisfaction of the robotic system work <u>Timing: After</u> <u>each field</u> <u>operation</u>	End user or Ecosystem chair feedback with a 1 to 5 scale (very good, good, ok, bad, very bad).	At least feedback between "Ok" to "very good"		
	<u>,</u>	L	TECHNICAL KP	IS	1		
		Unmai	nned Ground Veh				
3	Size of robot suitable for different crops	MET_TEC_UGV_05 b	Is the size of the robotic system suitable to the crop? <u>Timing: At the</u> <u>development</u> <u>phase</u>	Robot should be suitable to all vegetables (Sugar beets, pumpkin, onions, broccoli, lettuce etc.), vineyards and orchards. Comparing the dimensions of the tractors that LSP3 uses in 2021 with UGV dimensions.	Same size as currently used tractor or smaller.		
4	Hardware present and operational	MET_TEC_UGV_17	Hardware is present and works on robot.	UGV is equipped with a connectivity system for data transmission, GNSS positioning, mobile connection to the cloud	Yes. Robot can operate		

r					<i>c</i>
			Is there		successfully.
			hardware for		Comment.
			data		
			transmission,		
			for GNSS		
			positioning,		
			for mobile		
			connection to		
			the cloud?		
			Timing: At the		
			development		
			<u>phase</u>		
5	Electrical,	MET_TEC_UGV_20	Hardware is	The robotic platform should	Robot can
	hydraulic and		present and	provide electrical, hydraulic and	operate
	PTO output to		works on	PTO output to the implement.	successfully
	the		robot.	Is there hardware to provide	with the
	implement		Timing: At the	electrical, hydraulic and PTO	implement.
			development	output to the implement?	
			phase		
6	Robotics	MET_TEC_UGV_22	GUI	Record all types of messages	The robot
-	platform		communicatin	the robotic platform	operator is
	regroups the		g information	communicates.	able to receive
	data to		needed.	Confirmation that	the data s/he
	communicate		Timing: At the	hard/software is available and	needs to make
	with the user		development	functional.	decisions and
	with the user		phase		supervise.
7	3-point hitch	MET_TEC_UGV_07	Is the UGV	Do the implements and UGVs	Yes
<b>'</b>	3-point inten		equipped with	follow the same Cat or standard	103
			an equivalent		
				for the 3-point hitch dimensions	
			to a 3-point	and lifting capacity.	
			hitch. Does it	Record the UGV 3-point hitch dimensions	
			have a 3-point		
			hitch (ISO730,	Record the 3-point hitch of the	
			CAT I, II, or	implement	
			III)?		
			Timing: At		
			least once		
			during the		
			project		
			<u>(Before</u>		
			<u>treatment</u>		
			<u>season).</u>		
8	AB lines	MET_TEC_UGV_24	The AB lines	Are AB lines displayed correctly	No need for
	import from		are moved	in the robot management	AB line setup
	GNSS system		from a shape	software?	should be
			file to the	Ensure that AB lines from	necessary on
			robot	commercial systems in use in	the field robot
			management/	2021 can be imported into the	itself.
			planning	robotic system through FMIS	
			software.	and Farming controller	
			Timing: When	interfaces.	
			creating a new		
			path planning		
9	Performing in	MET_TEC_UGV_12	Ability to	Use the heavier tool of the	At least
	wet clay soil		perform a	Large-Scale Pilot (up to 400 kg)	"Suitable" to
1	wet thay soll	1	Periorina	Lange Jeane I not (up to 400 kg)	
			mission with	and record the level of easiness	

		[			[
			implements in	of the robot to handle it in a wet	"Very Easy"
			the limits of	clay soil (Very Easy - Easy -	assessment.
			the robotic	Suitable - Hard - Very hard)	
			systems.		
			Timing:		
			After the		
			<u>weeding</u> <u>season - At</u>		
			least once per		
			year		
10	Autonomy of	MET TEC UGV 04	The robot	Let the robot run in a loop until	Time > 8hours
10	the whole		should have	it stops, and record time during	
	robotic		an autonomy	the operation.	
	system		of minimum 8		
	System		-10 hours.		
			Timing:		
			During a		
			<u>specific test –</u>		
			once a year		
11	Teach in	MET_TEC_UGV_25	Precision of	Teach in: Driving routes can be	Deviation <
			teach in and	taught, including patterns of AB	5cm Feedback
			efficiency	lines and connecting headland	at least
			Timing: Once	turns.	Efficient
			a year after all	Deviation of the teach in. End	
			field	user feedback with a 1 to 4 scale	
			operation	(Very efficient, Efficient, Not	
				efficient, Unusable)	
12	Human	MET_TEC_UGV_01	Cases where	Record a description of the	<10%
	intervention		the robotic	intervention and the time	intervention
	in robotic		system cannot	allocated to it. Record the total	time
	work		work without	time used by the end user for	
			human	the whole weeding operation.	
			assistance	Determine the % of	
			Timing:	intervention time in relation to	
			During field	total time.	
			operations		
13	Farmer	MET_TEC_UGV_01	Competences	Record the number of	>10% easier
	competences		required for	operations consider as harder	operations
	for using the		farm workers,	than driving a tractor and the	
	robot		using robotic	competences required to	
			systems for	achieve them.	
			repetitive	Record the number of	
			work	operations consider as easier	
			Timing: At the	than driving a tractor and the	
			end of each	competences required to	
			spraying	achieve them.	
			<u>season</u>		
14	Deviation of	MET_TEC_UGV_02	Deviation of	Record the time of entry and	Percentage of
	the trajectory		the trajectory	the time of exit of 3 straight	deviation from
	of the towing		of the towing	rows of the UGV.	the planned
	system.		system.	Record the speed of the UGV in	trajectory
			Timing: After	those rows.	between 50
			<u>each</u>	Retrieve log of the UGV.	and 100 mm:
			operation		<10%
					Percentage of
					deviation from

15	Obstacle detection and avoidance	MET_TEC_UGV_03	Can the robot detect case of emergency? Does the robot avoid collision? <u>Timing: In the</u> <u>off season –</u> <u>At least twice</u>	Place a heavy (+40 kg min) container in the middle of the passageway in place of a man: record if the robot detects the obstacle and slow down. Record if the robot avoid collision. If not record if the collision was violent.	the planned trajectory above 100 mm: <2% The obstacle is detected. Collisions are avoided.
16	Capacity of robot and tractor to work under different conditions	MET_TEC_UGV_05	per year Condition where a robot couldn't work and where a tractor could. <u>Timing: After</u> <u>field</u> <u>operation –</u> <u>when it</u> <u>happens</u>	In practice, mechanical weeding or spraying can only be done under certain conditions (weather, state of the soil (e.g., moisture level), and growth stages of both the crop and the weeds), the robot must be able to work at least in those conditions where a tractor could pass. Record all situations where a robot couldn't work and where a tractor could. Define the expected work. Record all operation of the field. Determine the % of operations carried out by a robot.	50% of tractor-based operations are carried out autonomously
17	Equipment breakdown. Reliability of the UGV.	MET_TEC_UGV_09	Number and Importance of the breakdown. Ability to repair. <u>Timing: All</u> <u>along the</u> <u>process –</u> <u>when it</u> <u>happens</u>	Record all breakdown (hardware or software) and record the time needed to repair and if help from the constructor was needed. Record if the issue is documented. Determine: Number and % of small breakdown: less than 1h of repairs and no need of help from constructor. Number and % of medium breakdown: less than 2 hours of repairs or help of the constructors Number and % of serious breakdown: more than 2 hours of repairs.	90% of all mechanical breakdowns are documented or can be repaired by a user equipped for mechanical interventions by season. 2 small breakdown max per month. 2 medium breakdown max per season. 2 serious breakdown max per 10 years.

		· · · ·			
18	UGV works in	MET_TEC_UGV_10	UGV	Record the temperature min of	Be able to
	low		Performing a	the environment when the	work at low
	temperatures		mission in low	robot was used without issues	temperatures
			temperatures	link to temperature.	(-5°C).
			Timing:		
			During fields		
			operations –		
			for each		
			operation		
19	UGV works in	MET_TEC_UGV_11	UGV	Record the temperature min of	Be able to
	high		Performing a	the environment when the	work in high
	temperatures		mission in	robot was used without issues	heat (+40°C).
			high	link to temperature.	
			temperatures		
			Timing:		
			During fields		
			operations –		
			for each		
20	lan an a		operation	Descendence	<b>Efficient</b>
20	Improvement	MET_TEC_UGV_14	Areas for	Record any movement that the	Efficient.
	of guidance		improvement	robot does not do the way the	If not,
	and U-turn of		of guidance	farmer wants. Rate their	optimize the
	the UGV		and U-turn of	importance: End user feedback	path planning
			the UGV	with an 1 to 3 scale (Efficient,	and reduce
			<u>Timing:</u>	Not efficient, Unusable).	pass overs and
			During fields	Determine the number of	soil
			<u>operations</u>	"Unusable" comments.	compaction.
			<u>when it</u>		
21	Level of	MET_TEC_UGV_16	<u>happens</u> Does the	The robot should be robust	All robotic
21	system		weather	with an IP similar to tractors (IP	components
	deterioration		significantly	65-67).	are Robust (IP
	due to		deteriorate	Record breakdown caused by	65-67) or
	weather		the system?	the weather.	protected to
	Weather		Timing:	Determine repetitive	have a similar
			During fields	breakdowns of one component	robustness.
			operations –	due to weather.	
			when it		
			happens		
22	Trajectory	MET_TEC_UGV_19	Number of	Record the number of pass	< 2 pass overs
	optimisation/		pass overs.	overs during each operation.	
	Reduction of		Timing:		
	pass overs		During fields		
			operations -		
			At least twice		
			per spraying		
			season		
23	Correct	MET_TEC_UGV_21	Correct	Does the Robotic system detect	Yes
	calculation of		calculation of	an empty tank during an	
	the tank		the tank	operation? Is the tank empty?	
	reserve		reserve.		
			Timing:		
			During fields		
			During fields		
			operations -		

			per spraying		
			season		
			Implements	L	
24	Implement's ISOBUS compatibility	MET_TEC_IMP_06	Is the Communicatio n between ECUs (Electronics Control Unit) of vehicle and implement defined? <u>Timing: At the</u> <u>development</u> <u>phase</u>	CAN bus/ISOBUS compatibility.	ISOBUS based communicatio n within the implement- vehicle combination operate successfully.
25	Speed of the UGV	MET_TEC_IMP_01	Speed of the UGV. <u>Timing: After</u> <u>each field</u> <u>operation</u>	Tow implements that need a speed between 2km/h to 8 km/h. Record speed use for each implement. Record speed expectation for this tool. Record speed instruction (speed set in the path planning instructions). [speed difference for each tool= speed expectation- speed use]	speed difference <1km/h
26	Spraying coverage	MET_TEC_IMP_03	Is spraying homogeneous in all the canopy? <u>Timing:</u> <u>Before and</u> <u>After each</u> <u>field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u>	<ul> <li>Place papers above 3 leaves, under 3 leaves, 3 in the alley, 3 in a row, 3 just out of the field.</li> <li>Spray with the robot. Check and record which paper are wet which are not.</li> <li>= Number of paper of one type wet / Total number of papers</li> </ul>	Above leaves: 100% Under leaves: 80%? In the alley: <5% Out of the field: 0%
27	Detection of nozzle obstruction	MET_TEC_IMP_04	Record of nozzle obstruction. Timing: After each field operation – when it happens	Record each nozzle obstruction. Record if the robotic system has detected it or not. Determine the % of not detected nozzle obstruction.	95% of nozzle obstruction detected.
28	Automated cleaning and maintenance	MET_TEC_IMP_05	Is the tank well cleaned? Is the maintenance of the sprayer enough? <u>Timing: After</u> <u>spraying</u> <u>operations -</u>	End user and technician feedback with a 1 to 5 scale (very good, good, ok, bad, very bad)	≤2

			At least twice		
29	Implement communicatio n with robotic platform / activating supply sources	MET_TEC_IMP_08	per seasonConsumptionof supplysources.Timing:During fieldoperation - Atleast twice perseason	Record situations where the robotic system can optimize its consumption (energy or consumable).	Robotic system can optimize its consumption.
30	Production of ISOXML files to be sent to the FMIS	MET_TEC_IMP_10	Recording the as-applied information of field application and producing ISOXML file available on the ISOBUS terminal. <u>Timing:</u> <u>During each</u> <u>field</u> <u>application</u>	Acquisition of as-applied amount (Sprayer) together with geo-location of applied points.	To represent the behaviour of the implements during field application.
31	Full load tank autonomy	MET_TEC_IMP_11	Full load a tank. Record the time taken for it to empty during autonomous operations. <u>Timing:</u> <u>During a</u> <u>spraying</u> <u>operation - At</u> <u>least twice per</u> <u>weeding</u> season	The user can fill the tank of the sprayer during a mission to a full-load tank autonomy of 60 min.	Autonomy of 60 min minimum
		Far	ming Controller 8	₹ FMIS	
32	Presentation of geospatial data	MET_TEC_F-C_15	Virtual map of the plot. <u>Timing: At the</u> <u>development</u> <u>phase.</u>	Is there a virtual map of the plot?	Presence of a virtual map of the plot usable during the operation for the end- user.
33	Communicatio n protocols between implements and the machinery established	MET_TEC_F-C_08	Is it possible to link implements and machinery such that they work together?	Establish communication protocols in all levels: Use of ISOBUS or TCP/IP or other protocols to enable communication from the FC up to the implement/UGV. Count incidences where help of dealer / manufacturer is required to make the	No incidences.

			<u>Timing: Once</u> <u>for each</u> <u>implement.</u>	implement and UGV work with the FC.	
34	Data retrieved from operations are properly displayed and understood	MET_TEC_F-C_06	End-users are able to find and understand the way the data is displayed. <u>Timing: One</u> <u>time per year</u> <u>with 5 users</u> <u>each time.</u>	Receive data from sensors: perception information from the field (examples: soil and weather conditions, 3D mapping of the field and the crops, GPS data for the position of the tractor, diesel level sensor, heat of engine sensor, remote supervision, camera data, etc.). Ask end-users a description of the information displayed. Ask them to find specific information (speed, position, progress of the mission etc.)	The farmer is able to find and understand the information that is displayed. The farmer is able to make decisions from the information displayed (ex: if the diesel levels are low, then he can refill, etc.).
35	Autonomy to respond to unforeseen events	MET_TEC_F-C_09	Robot's respond to unforeseen events in a graceful manner. <u>Timing:</u> <u>During a field</u> <u>operation – At</u> <u>least once a</u> <u>year</u>	Place a heavy (+40kg min) container in the middle of the passageway, on a headland, make the FC believe that the wind is rising, that it is starting to rain: in all cases, record the reaction of the robotic system. Determine if the reaction of the robotic system is appropriate (it bypasses the obstacle without damaged plants or skipping work it could do; it stops its operation due to weather issues;) Number of not appropriate reaction	Successful respond to unforeseen events.
36	Input information of each UGV and implement in the FMIS.	MET_TEC_F-C_11	Ability to input information of each UGV and implement in the FMIS. <u>Timing: Once</u> for each robot and implement.	Store description of all robots and implements on the farm (include weight, size, working width, fuel autonomy, source of fuel, which connectors are available, etc.) Indicate the ability or non- ability. Define data size.	Yes.
37	Prescription map for field operation	MET_TEC_F-C_12	Is the FMIS well construct to create a prescription map for field operation? <u>Timing: Once</u> <u>a year.</u>	End user feedback with a 1 to 4 scale (Nothing wrong, Efficient, Not efficient, Unusable)	At least "Efficient" to "Nothing wrong",

20	Deufeun		<b>Eff:</b>	Final scene free dia a 1911 day d	A + 1 +
38	Performance	MET_TEC_F-C_13	Efficiency of	End user feedback with a 1 to 4	At least
	assessment		the user	scale (Nothing wrong, Efficient,	"Efficient" to
	visualisation.		interface to	Not efficient, Unusable).	"Nothing
			visualize as-		wrong"
			applied		
			information		
			and		
			performance		
			assessment.		
			Timing: Once		
			<u>a year.</u>		
39	User interface	MET_TEC_F-C_14	Efficiency of	End user feedback with a 1 to 4	At least
	inputs task-		the user	scale (Nothing wrong, Efficient,	"Efficient" to
	related		interface to	Not efficient, Unusable)	"Nothing
	parameters		input task-		wrong"
	•		related		U
			parameters.		
			Timing: Once		
			a year.		
40	Conditions to	MET_TEC_F-C_01	Ability to	Record if it is possible or not.	Yes, it is
	be met before		input the		possible
	execution of		conditions		pooloio
	tasks		under which a		
	tushs		task is		
			performed		
			into the		
			robotic		
			system.		
			Timing:		
			Before		
			starting fields		
			operations -		
			At least once		
			per task		
41	Resources for	MET_TEC_F-C_02	Ability to	Record if it is possible or not.	Yes, it is
71	the execution		input the		possible
	of tasks		resources		possible
	01 (03)(3		available or		
			not for each		
			task.		
			Timing:		
			Before		
			starting fields		
			operations -		
			At least once		
			<u>per task</u>		

10	Constraints or		Ability to	Record if it is possible or pat	Voc. it is
42	Constraints on when and	MET_TEC_F-C_03	Ability to input time	Record if it is possible or not.	Yes, it is possible
			•		possible
	how tasks should be		constrain for each task and		
	executed		to parameter		
			each task.		
			Timing:		
			<u>Before</u>		
			starting fields		
			operations -		
			At least once		
			<u>per task</u>		2221
43	Robot's	MET_TEC_F-C_04	Does the	Leave less fuel than the mission	>90%
	battery		farmer get a	needs in the tank of the UGV.	
	notification		notification	Start the mission and record, if	
			when the level	you are notified, whether you	
			of fuel is low	have time to stop the robot	
			and before it	before it stops by itself.	
			reaches 0?		
			<u>Timing:</u>	[ = Number of times the robot is	
			During a field	refilled before it runs out of	
			operation - At	power / Number of tests of this	
			least twice per	measure]	
			<u>season</u>		
44	Precision of	MET_TEC_F-C_05	Reality of the	Have a digital copy of the field	At least
	the digital		сору.	in a virtual environment	"Similar" to
	twin of the		<u>Timing:</u>	alongside with the CAD files of	"exactly the
	field		<u>Before</u>	the used resources. This digital	same"
			starting and	copy should be precise.	
			after spraying	End user feedback with a 1 to 5	
			<u>season. At</u>	scale (Exactly the same, strong	
			least twice per	likeness, similar, some defect,	
			<u>year</u>	not a copy)	
45	FMIS provides	MET_TEC_F-C_07	Communicatio	Change a parameter in the FMIS	Communicatio
	information		n between the	and record if it was changed in	n between the
	about the		FC and the	the FC.	FC and the
	needs of the		FMIS.		FMIS is
	crops		<u>Timing:</u>		achieved.
			<u>Before</u>		
			starting a field		
			operation - At		
			least twice per		
			<u>season.</u>		
46	Input task	MET_TEC_F-C_10	Ability to	Store all field operations with	Yes.
	information in		input	related information (e.g.,	
	the FMIS.		information	technical, financial, etc.)	
			on each task	Indicate if it is possible or not to	
			in the FMIS.	do it.	
			Timing: Once		
			<u>a year - At</u>		
			least twice per		
			<u>season.</u>		
47	End-user's	MET_TEC_F-C_16	Can the end-	Record case where the end user	No cases
	ability to		user intervene	cannot intervene and what s/he	occur.
	intervene		at any time	would have done.	
			during an		

			operation if		
			the		
			circumstances		
			so require?		
			Timing: All		
			along the		
			process - At		
			least twice per		
			<u>season.</u>		
48	Ability to	MET_TEC_F-C_17	Can the	Record if the robotic system	Both possible.
	pause and		operation be	can be paused during its	At least "ok"
	resume tasks.		paused and	operation. Record if it can be	to "very easy".
			resumed?	resumed. Record the easiness	
			Timing:	of this process: End user	
			Before	feedback of their control of the	
			starting the	robotic system with a 1 to 5	
			season.	scale (very easy, easy, ok,	
			<u></u>	difficult very difficult).	
			NON-TECHNICAL		
			Safety		
49	Data security	MET N-TEC saf 03	Ensure that	Use an expert, like a data	99% uptime
	,		data cannot	integrity expert, cloud security	guaranteed of
			be improperly	expert from one of the	the robot.
			accessed or	institutes to perform an	
			modified).	integrity test (From the land	
			Timing: Once	survey to the robotic mission	
			<u>a year.</u>	and data record by the robotic	
			<u>u yeur.</u>	system in the field).	
50	Compliance	MET_N-TEC_saf_04	Check the list	Send list to robot supplier for	Robotic
	with Machine		of standards	verification that the standards	companies are
	directive and		and	are harmonized.	in compliance
	the EU		regulations		with the
	legislations		collected in	Number of standards company	required
			WP1 are	is in compliance/not in	standards so
			compliant	compliance.	the product
			with the	compliance.	can be CE
			robotic		marked.
					markeu.
			system.		
			Timing: Once		
<b>F1</b>	Injurios and		<u>a year.</u>	Pacard the number of iniuries	Injuros
51	Injuries and	MET_N-TEC_saf_01	Injuries to	Record the number of injuries	Injures
	danger		human or	suffer by a human and the	≤2/season
1					Danger ≤ 2
1	created by the		dangerous	number of injured humans.	
	created by the robot		situation	Record the number of	
			situation created by the	Record the number of dangerous situation (users	Danger 32
			situation created by the robotic	Record the number of dangerous situation (users perspective when/if they have	Danger 32
			situation created by the	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe	Danger 3 2
			situation created by the robotic	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt	
			situation created by the robotic system.	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe	
			situation created by the robotic system. <u>Timing: All</u>	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt	
			situation created by the robotic system. <u>Timing: All</u> <u>along the</u>	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt them) and their level (Minor=	
			situation created by the robotic system. <u>Timing: All</u> <u>along the</u> <u>process –</u> <u>when it</u>	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt them) and their level (Minor= No consequences, Significant = Minor injuries / Minor damages	
			situation created by the robotic system. <u>Timing: All</u> <u>along the</u> <u>process –</u>	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt them) and their level (Minor= No consequences, Significant = Minor injuries / Minor damages of other equipment / Minor	
			situation created by the robotic system. <u>Timing: All</u> <u>along the</u> <u>process –</u> <u>when it</u>	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt them) and their level (Minor= No consequences, Significant = Minor injuries / Minor damages of other equipment / Minor damage of public or private	Danger 3 2
			situation created by the robotic system. <u>Timing: All</u> <u>along the</u> <u>process –</u> <u>when it</u>	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt them) and their level (Minor= No consequences, Significant = Minor injuries / Minor damages of other equipment / Minor damage of public or private property / Temporary damage	Dunger 3 2
			situation created by the robotic system. <u>Timing: All</u> <u>along the</u> <u>process –</u> <u>when it</u>	Record the number of dangerous situation (users perspective when/if they have felt that the robot was unsafe or if the robot would hurt them) and their level (Minor= No consequences, Significant = Minor injuries / Minor damages of other equipment / Minor damage of public or private	

			Labacity of aff	End user feedback of their	i nu user
55	Capacity of	MET_N-TEC_lab_01	<u>Timing: Once</u> <u>a year</u> Capacity of an	The durant fact that the state of the st	End user
	lanninputs		inventory of goods?	not enicient, onusable)	wrong"
34	inventory of farm inputs		well construct to keep the	scale (Nothing wrong, Efficient, Not efficient, Unusable)	"Efficient" to "Nothing
54	Ability to keep	MET_N-TEC_lab_06	Is the FMIS	End user feedback with a 1 to 4	At least
			<u>each year</u> Labour		
			least twice		
			process - At		
			along the		etc.
			Timing: All		adjustment
			driver can?		implement,
			functioning as a tractor		Implement: height of the
			robot's		etc. Implement:
			and the	not monitored.	the implement
	functions		implement	Indicate number of parameters	row, height of
	and robot's		that drives the	driver can.	chaining of
	implement		parameters	robotic system as a tractor	<u>UGV</u> : Speed,
22	Possibility to monitor	MET_N-TEC_saf_05	user monitor	monitor parameters of the	Able to monitor:
53	Possibility to	MET NATEC cof OF	<u>happens.</u> Can the final	Determine if the final user can	Able to
			<u>when it</u>		
			process –		
I			along the		
l			Timing: All		
			regulation.		
			the local law and		
			comply with	Number of cases.	
	and regulation		system do not	the local law and regulation.	
	with local law		the robotic	system does not comply with	
52	Compliance	MET_N-TEC_saf_02	Cases where	Record case where the robotic	Zero cases.
				Catastrophic)	
				for Critical-4 for	
				of the situation (1 for minor-2 for significant-3	
				dangerous situation×level	
				Danger=number of	
				× number of human injured	
				Injures = number of injures	
I				Professional diseases).	
I				Catastrophic = Death / Death threat / Permanent disability /	
I				to the environment ,	
				property / Long term damaged	
				damage of public or private	
				robotic system / Loss or big	
				professional disease / Serious injure / Loss or damaged of the	
				death threat / Temporary	

to manage the r obotic systemControl the robotic system with only a user's manual and a training. Timing.At least once per season.with a 1 to 5 scale (very easy, "experienced user of this control user of this control training. Timing. At least once per season.Operational treatment: the robotic and the spraying system should be quick to install and start spraying in cases of emergency spraying and in the available opportunity windows. • Record time between starting at the field to the robot is attaching the motor and the implement toupling to the robot. • Record time between starting at the field to the moment to transport of the robotic systemMET_N-TEC_lab_03 season.Can the robotic systemAll Yes. Easy to Ok assessment at the field to the moment the robotic starts its mission.No uncouncetion assessment assessment a season.58Use of conventional toolsMET_N-TEC_lab_04 maintained vith a conventional toolsMET_N-TEC_lab_05 maintained along the season.Indicate the tool needed to maintained toolsNo uncouncetion assessment tools59Feasibility of the workplanMET_N-TEC_lab_05 maintained toolsMet_N-TEC_lab_05 maintained assesMet and the solution and the sobot of the imaintained toolsAll t						
56     Launching a mission in field     MET_N-TEC_lab_02     Time needed to launch a mission in field.     Operational treatment: the robot and the spraying system should be quick to install and start spraying in cases of available opportunity windows.     <31minutes       57     Open road transport of transport of system     MET_N-TEC_lab_03     Can the robot system (UGV + Tools) be load on a trailero within a van?     Record time between attaching the implements to the robot and the ransport.     All Yes. Easy to Ok assesson.       58     Use of conventional tools     MET_N-TEC_lab_04     Can the robotic system (UGV + Tools) be load on a trailero within a van?     Record time tool needed to maintained with conventional tools     MET_N-TEC_lab_04     Record fino. If yes, evaluate the maintained with conventional tools     All Yes. Easy to Ok assessment       59     Feasibility of the workplan the workplan the workplan     MET_N-TEC_lab_05     Measure the ramber asson     End user feedback with a 1 to 5 scale (Perfect, Feasible easible, Need few changes, Impossible)     At least "not the strasible asson				system with only a user's manual and a training. <u>Timing: At</u> least once per	and assessment by an experienced user of this control	Experienced user assessment at least "ok" to
transport of the robotic systemransport of the robotic systemrobotic system (UGV + Tools) be load on a trailer or within a van? Timing: At least once per seasonIf yes, evaluate the maneuverability of your route (Easy - Ok - Hard).Easy to Ok assessment58Use of conventional toolsMET_N-TEC_lab_04The hardware can be maintained with conventional tools that the farmer uses. Timing: Atl along the process - Atl each maintenanceIndicate the tool needed to maintain the robot or the implementNo unconventional al tool is needed.59Feasibility of the workplanMET_N-TEC_lab_05 MET_N-TEC_lab_05Measure the feasibility of the workplan.End user feedback with a 1 to 5 scale (Perfect, Feasible easily, not that simple but feasible, Need few changes, Impossible)At least "not that simple but feasible" to "Perfect".	56	mission in	MET_N-TEC_lab_02	Time needed to launch a mission in field. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation –</u> <u>when it</u> <u>happens At</u> <u>least once per</u>	robot and the spraying system should be quick to install and start spraying in cases of emergency spraying and in the available opportunity windows. • Record time between starting the motor and the implement coupling to the robot. • Record time between attaching the implements to the robot and the robot is attached on the transport. • Record time from the moment the transport arrived at the field to the moment the robot starts its mission.	<31minutes
conventional toolscan be maintained with conventional tools that the farmer uses. Timing: All along the process - At each maintenancemaintain the robot or the implementunconvention al tool is needed.59Feasibility of the workplanMET_N-TEC_lab_05Measure the fasibility of the workplan.End user feedback with a 1 to 5 scale (Perfect, Feasible easily, not that simple but feasible, Need few changes, Impossible)At least "not that simple but feasible" to "Perfect".	57	transport of the robotic	MET_N-TEC_lab_03	robotic system (UGV + Tools) be load on a trailer or within a van? <u>Timing: At</u> <u>least once per</u>	If yes, evaluate the maneuverability of your route	Easy to Ok
the workplan       feasibility of the workplan.       scale (Perfect, Feasible easily, not that simple but feasible, but feasible.       that simple but feasible.         Timing: At least once per season       season       not that simple but feasible.       to "Perfect".	58	conventional	MET_N-TEC_lab_04	The hardware can be maintained with conventional tools that the farmer uses. <u>Timing: All</u> <u>along the</u> <u>process – At</u> <u>each</u>	maintain the robot or the	unconvention al tool is
Ethics	59	-	MET_N-TEC_lab_05	feasibility of the workplan. <u>Timing: At</u> <u>least once per</u>	scale (Perfect, Feasible easily, not that simple but feasible,	that simple but feasible"

		· · · · · · ·			
60	Additional	MET_N-	<ul> <li>Is there is a</li> </ul>	The system should not	The use of the
	health risk	TEC_Eth_03	need for an	invalidate the health insurance	robot doesn't
	and/or need		additional	of the people using it (high-risk	recommend a
	for additional		insurance?	sports such as sky diving require	supplementar
	insurance for		<ul> <li>Risk to user's</li> </ul>	additional insurance - we don't	y health
	the farmer		health and	want this for the R4C robotic	insurance.
			difficulty of	system).	
			work.	<ul> <li>Is an additional insurance</li> </ul>	
			<ul> <li>Time invested</li> </ul>	necessary?	
			in discussions	Record time invested in	
			with	discussions with insurance	
			insurance	companies.	
			companies.	Record for each conventional	
				and autonomous system: -	
			Timing:	Amounts and type of	
			<u>Before</u>	pesticides and herbicides	
			starting the	used.	
			<u>field</u>	- Number of operations that	
			<u>operations</u>	may cause human exposure	
			when	to pesticides	
			discussing	- Number of operations that	
			with insurance	have a lower health risk	
			companies.	- Number of operations that	
			<u>After each</u>	have a higher health risk	
			season.	- Time of exposure: • To	
				pesticides • To tractor	
				vibration (with a	
				conventional system)	
				<ul> <li>Hours of physical work (with both conventional and</li> </ul>	
				autonomous system)	
61	Liability	MET_N-	Presence of a	The system should not	The use of the
01	insurance of	TEC_Eth_04	health	invalidate the liability insurance	robot doesn't
	the testing	120_201_04	insurance of	of the property on which the	recommend a
	property		the operator	R4C robotic system is used.	supplementar
	property		Time invested	Indicate presence/absence of	y health
			from the end	health insurance.	insurance.
			user to		
			convince the		
			insurance		
			company.		
			Timing:		
			Before		
			starting the		
			field		
			operations -		
			when		
			discussing		
			with insurance		
			companies.		
62	Farmer's	MET_N-	Possibility to	Farmer should be able to	Yes, the
	understanding	 TEC_Eth_01	follow the FC	understand the decisions made	farmer is able.
			decision.	by the system.	
			Timing:	Record if it is possible and	
			Before	understandable or not.	
			starting a field		

					1
			operation - At		
			least twice per		
			season		
63	Farmer's	MET_N-	Ability to	Farmer should be able to	Yes, the
	ability to	 TEC_Eth_02	manually	intervene in the decisions made	farmer is able.
	, intervene in		, modified each	by the system when needed.	
	the decision		decision of	Record if it is possible or not.	
	making		the FC.		
	пакінg		Timing:		
			<u>Before</u>		
			starting a field		
			operation - At		
			least twice per		
			<u>season</u>		
			Economics		
64	Cost-	MET_N-	User time to	For both conventional and	Be cost
	effectiveness	TEC_eco_01	prepare the	autonomous system:	effective.
	of the robotic		robotic	• Time between starting the	
	system		system and all	motor and the implement	
	,		economic	coupling to the robot.	
			aspects.	• Time between attaching the	
			Timing:	implements to the robot and	
			Regional	the robot is attached on the	
			data: Year 2.	transport	
			• All other	• Time from the moment the	
			metrics: Once	transport arrived at the field to	
			each year -	the moment when the	
			Validation of	transport leaves with the robot	
			the minimum	Cost of the Land Survey	
			<u>viable</u>	<ul> <li>How many field operations</li> </ul>	
			<u>product</u> .	are necessary to have a clean	
				plot?	
				<ul> <li>Fuel consumption per hectare</li> </ul>	
				<ul> <li>Quantity of pesticide and</li> </ul>	
				herbicides used	
				<ul> <li>Type of pesticide and</li> </ul>	
				herbicides used	
				• Yield	
				• Cost of: - Herbicide – Fertilizer	
				- Plant protection products -	
				Fuel – Harvest	
				Fixed costs	
				Investments	
				Lifetime of investments	
				Current interest rate	
				Number of operations	
				• Total spending per hectare	
				with robotic system	
				• Total spending per hectare	
				with conventional system	
				<ul> <li>Number of hectares that the</li> </ul>	
				robotic system can handle	
				<ul> <li>Number of hectares of the</li> </ul>	
				farm	
I					
				Data about the region:	
		•	•		

				<ul> <li>Total Area (ha)</li> <li>Geographical relevance and boundaries (e.g., Covered by cooperatives, local region, catchment)</li> <li>Number of farms within the area, type of farmland (soil type), crops produced, farm sizes and structure, employees</li> <li>Number of citizens</li> <li>Data of ~100 Farmer: education, age, farm size and type of farm and crops produced, questions about farmers perception of various autonomous systems, needs, barriers, technical problems, speed, risk, skills, convenience</li> <li>Assess the number of jobs that could be created in relation to Agri-and IT business</li> </ul>	
				spraying)	
				Cost per hectare of the task	
65	Social acceptance	-	Social Measure the social acceptance of the proposed robotic solution. <u>Timing: Once</u> <u>at the end of</u> <u>each year -</u> <u>Validation of</u> <u>the minimum</u> <u>viable</u> <u>product.</u>	End-user feedback. The robotic solution is: Not acceptable (no useful outcome, easiness to use, or benefit) – Acceptable (some benefit) - Highly acceptable (end-user identifies high benefit from the use of the robot)	Acceptable or highly acceptable.

# 2.2.4 LSP 4 – The Netherlands – KPIs

Below, the KPIs for LSP 4 are presented.

	AGRONOMIC KPIs						
КРІ	KPI title	Related measurable metric from WP1 (D1.4)	Measurement	Description	Target		
1	Plant damage/ destruction	MET_AGRO_1	Number of damaged or destroyed plants that are not	With a tractor and with a robot equipped with the 'smart' mechanical weeder and also with a conventional mechanical weeder, for each operation	<2% damage with a good quality of weeding		

			predisposed	follow the pulling system and	
			to be	record the number of damaged	
			wounded.	plants. Record the number of	
			Timing: at	plants per number of meters	
			least 2	analysed. If a damaged plant is	
			times/year	detected, record the origin of	
			times/year	the damage: not straight row,	
				implements badly adjust (too	
				strong), robotic guidance or	
				other origin.	
				Crop damage % and crop	
				destruction % related to:	
				-crop management (=cuttings	
				poorly attached to their stakes	
				and not straight row),	
				-UGV guidance law,	
				- Implement adjustment, - Other	
2	Dirty crops	MET_AGRO_2	Plants cover	issues. Qualify the condition of the	Dirty crops <
2	Dirty crops		with dirt or	knives (good - worn – broken).	20%
			sand	Record the number of dirty	2070
			Timing:	plants and plants studied.	
			Before and	Determine the percentage of	
			after weeding	dirty plants.	
			operation – At	anty plants.	
			least twice per		
			weeding		
			season		
3	Agronomic	MET_AGRO_3	Agronomic	End user or Ecosystem chair	At least
	performance		satisfaction of	feedback with a 1 to 5 scale	feedback
	of the robot		the robotic	(very good, good, ok, bad, very	between "Ok"
			system work	bad).	to "very good"
			Timing: After		
			each field		
			<u>operation</u>		
		Unma	TECHNICAL KP		
4	Size of robot	MET_TEC_UGV_05	Is the size of	Robot should be suitable to all	Track width of
	suitable for	b	the robotic	vegetables (Sugar beets,	the UGV must
	different	~	system	pumpkin, onions, broccoli,	match with
	crops		suitable to the	lettuce etc.), vineyards and	the row
	5.005		crop?	orchards.	spacing of the
			Timing: At the	Record the track width of the	crop or with
			development	machine, the width of the	multiple rows
			phase	knives, the height of the	of the crop
			+	machine	(per crop
					different,
					most common
					spacings are
					12,5cm; 25cm;
					50cm; 75cm.)
					Crop size and
					height should
					match the
					knives width
		1	1	1	

					and machine height
5	Hardware present and operational	MET_TEC_UGV_17	Hardware is present and works on robot. Is there hardware for data transmission, for GNSS positioning, for mobile connection to the cloud? <u>Timing: At the</u> <u>development</u> <u>phase</u>	UGV is equipped with a connectivity system for data transmission, GNSS positioning, mobile connection to the cloud	Yes. Robot can operate successfully. Comment.
6	Electrical, hydraulic and PTO output to the implement	MET_TEC_UGV_20	Hardware is present and works on robot. <u>Timing: At the</u> <u>development</u> <u>phase</u>	The robotic platform should provide electrical, hydraulic and PTO output to the implement. Is there hardware to provide electrical, hydraulic and PTO output to the implement?	Robot can operate successfully with the implement.
7	Robotics platform regroups the data to communicate with the user	MET_TEC_UGV_22	GUI communicatin g information needed. <u>Timing: At the</u> <u>development</u> <u>phase</u>	Record all types of messages the robotic platform communicates. Confirmation that hard/software is available and functional.	The robot operator is able to receive the data s/he needs to make decisions and supervise.
8	3-point hitch	MET_TEC_UGV_07	Is the UGV equipped with an equivalent to a 3-point hitch. Does it have a 3-point hitch (ISO730, CAT I, II, or III)? <u>Timing: At</u> <u>least once</u> <u>during the</u> <u>project</u> ( <u>Before</u> <u>weeding</u> <u>season).</u>	Do the implements and UGVs follow the same Cat or standard for the 3-point hitch dimensions and lifting capacity. Record the UGV 3-point hitch dimensions Record the 3-point hitch of the implement	Yes
9	AB lines import from GNSS system	MET_TEC_UGV_24	The AB lines are moved from a shape file to the robot management/ planning software.	Are AB lines displayed correctly in the robot management software? Ensure that AB lines from commercial systems in use in 2021 can be imported into the robotic system through FMIS	AB lines can be imported

			Time in a 14/1	and Family constraint	I
			Timing: When	and Farming controller	
			creating a new	interfaces.	
			path planning		
10	Performing in	MET_TEC_UGV_12	Ability to perform a	Use the heavier tool of the	At least
	wet clay soil		mission with	Large-Scale Pilot (up to 750 kg	"Suitable" to
			implements in	with Robotti 150D and 1500 kg	"Very Easy" assessment.
			the limits of	with Robotti LR kg) and record the level of easiness of the robot	assessment.
			the robotic	to handle it in a wet clay soil	
			systems.	(Very Easy - Easy - Suitable -	
			Timing:	Hard - Very hard)	
			After the		
			weeding		
			season - At		
			least once per		
			year		
11	Autonomy of	MET_TEC_UGV_04	The robot	Let the robot run in a loop until	Time > 8hours
	the whole		should have	it stops, and record time during	
	robotic		an autonomy	the operation.	
	system		of minimum 8		
			-10 hours.		
			<u>Timing:</u>		
			During a		
			<u>specific test –</u>		
			once a year		
12	Use of	MET_TEC_UGV_06	Can the	Work with current common	All
	common		robotic	mechanical weeding tools for	implements
	implements		system use one type of	vineyards (vineyards ploughshares and knives, disk	usable. At least
			each current	harrow, Kress Fingers, rotatory	feedback
			common	tool mower, ripper) and	between "Ok"
			mechanical	vegetables (hoeing machine).	to "very
			weeding		good".
			implement?	The UGV can tow Hoeing	0
			Are they	machine (a Graford robocrop	
			simple to	side-shift guided Steketee	
			attach?	weeder with normal V- shaped	
			Timing: Once	knives, 75cm row spacing)	
			<u>a year after all</u>		
			<u>field</u>	End user and Technical chair	
			operation	feedback with a 1 to 5 scale	
				(very good, good, ok, bad, very	
				bad) concerning the easiness to	
12	Tooch in		Drocision of	attach those implements	Doviation
13	Teach in	MET_TEC_UGV_25	Precision of	Teach in: Driving routes can be	Deviation <
			teach in and efficiency	taught, including patterns of AB lines and connecting headland	5cm Feedback at least
			Timing: Once	turns.	Efficient
			<u>a year after all</u>	Deviation of the teach in. End	Lincient
			field	user feedback with a 1 to 4 scale	
			operation	(Very efficient, Efficient, Not	
				efficient, Unusable)	
14	Human	MET_TEC_UGV_01	Cases where	Record a description of the	<10%
	intervention		the robotic	intervention and the time	intervention
	in robotic		system cannot	allocated to it. Record the total	time
	work		work without	time used by the end user for	

-		I	1.		,
			human	the whole weeding operation.	
			assistance Timing:	Determine the % of intervention time in relation to	
			During field	total time.	
			operations		
15	Farmer	MET_TEC_UGV_01	Competences	Record the number of	>10% easier
15	competences		required for	operations consider as harder	operations
	for using the		farm workers,	than driving a tractor and the	operations
	robot		using robotic	competences required to	
			systems for	achieve them.	
			repetitive	Record the number of	
			work	operations consider as easier	
			Timing: At the	than driving a tractor and the	
			end of each	competences required to	
			weeding	achieve them.	
			<u>season</u>		
16	Deviation of	MET_TEC_UGV_02	Deviation of	Record the time of entry and	Percentage of
	the trajectory		the trajectory	the time of exit of 3 straight	deviation from
	of the towing		of the towing	rows of the UGV.	the planned
	system.		system.	Record the speed of the UGV in	trajectory
			Timing: After	those rows.	above 25mm:
			each	Retrieve log of the UGV.	<10%
47	<b>C i i C</b>		operation		500/ (
17	Capacity of robot and	MET_TEC_UGV_05	Condition	In practice, mechanical weeding	50% of
	tractor to		where a robot couldn't work	or spraying can only be done under certain conditions	tractor-based operations are
	work under		and where a	(weather, state of the soil (e.g.,	carried out
	different		tractor could.	moisture level), and growth	autonomously
	conditions		Timing: After	stages of both the crop and the	autonomously
	contaitions		field	weeds), the robot must be able	
			operation –	to work at least in those	
			when it	conditions where a tractor	
			happens	could pass.	
				Record all situations where a	
				robot couldn't work and where	
				a tractor could. Define the	
				expected work.	
				Record all operation of the field.	
				Determine the % of operations	
				carried out by a robot.	
18	Blockage	MET_TEC_UGV_08	Detection of	Intentionally cause a blockage	> 95%
	detection and		blockage of	of the tool (with a branch or stuff on field) record if ofter 1	blockages
	rectification		mechanical tools and the	stuff on field) record if after 1	detected > 90%
			ability to	minute of blockage, the robotic system has done nothing to	> 90% rectified
			overcome.	rectify it. Otherwise, record if it	rectined
			Timing:	had worked.	
			During field	Record all unintentionally	
			operations -	caused blockages.	
			At least twice	Determine: % of blockages	
			per weeding	detected % of blockages	
			season	rectified	
19	Equipment	MET_TEC_UGV_09	Number and	Record all breakdown	90% of all
	breakdown.		Importance of	(hardware or software) and	mechanical
1	Reliability of		the	record the time needed to	breakdowns
1	Reliability of				

			A 1 1111		· · · · · · · · · · · · · · · · · · ·
			Ability to	constructor was needed. Record if the issue is	documented or can be
			repair.	documented.	
			<u>Timing: All</u> along the	Determine:	repaired by a user equipped
				Number and % of small	for mechanical
			<u>process –</u> when it	breakdown: less than 1h of	interventions
			happens	repairs and no need of help	by season.
			nappens	from constructor.	2 small
				Number and % of medium	breakdown
				breakdown: less than 2 hours of	max per
				repairs or help of the	month.
				constructors	2 medium
				Number and % of serious	breakdown
				breakdown: more than 2 hours	max per
				of repairs.	season.
					2 serious
					breakdown
					max per 10
					years.
20	UGV works in	MET_TEC_UGV_10	UGV	Record the temperature min of	Be able to
	low		Performing a	the environment when the	work at low
	temperatures		mission in low	robot was used without issues	temperatures
			temperatures	link to temperature.	(-5°C).
			<u>Timing:</u> During fields		
			operations –		
			for each		
			operation		
21	UGV works in	MET_TEC_UGV_11	UGV	Record the temperature min of	Be able to
	high		Performing a	the environment when the	work in high
	temperatures		mission in	robot was used without issues	heat (+40°C).
			high	link to temperature.	
			temperatures		
			Timing:		
			During fields		
			<u>operations</u>		
			for each		
22	Improvement	MET_TEC_UGV_14	operation Areas for	Record any movement that the	Efficient.
	of guidance		improvement	robot does not do the way the	If not,
	and U-turn of		of guidance	farmer wants. Rate their	optimize the
	the UGV		and U-turn of	importance: End user feedback	path planning
			the UGV	with an 1 to 3 scale (Efficient,	and reduce
			Timing:	Not efficient, Unusable).	pass overs and
			During fields	Determine the number of	soil
			<u>operations</u> –	"Unusable" comments.	compaction.
			when it		
			happens		
23	Level of	MET_TEC_UGV_16	Does the	The robot should be robust	All robotic
	system		weather	with an IP similar to tractors (IP	components
	deterioration due to		significantly deteriorate	65-67). Record broakdown caused by	are Robust (IP
	due to weather		the system?	Record breakdown caused by the weather.	65-67) or protected to
1	weather		-		
			Timing	Determine renetitive	have a similar
			<u>Timing:</u> During fields	Determine repetitive breakdowns of one component	have a similar robustness
			<u>Timing:</u> During fields operations –	Determine repetitive breakdowns of one component due to weather.	have a similar robustness.

			when it		
			when it		
24	Trajectory	MET_TEC_UGV_19	<u>happens</u> Number of	Record the number of pass	
24				overs during each operation.	< 2 pass overs
	optimisation/		pass overs.	overs during each operation.	
	Reduction of		Timing:		
	pass overs		During fields		
			operations -		
			At least twice		
			per weeding		
			<u>season</u>		
	T	Γ	Implements		Γ
25	Implement's	MET_TEC_IMP_06	Is the	CAN bus/ISOBUS compatibility.	ISOBUS based
	ISOBUS		Communicatio		communicatio
	compatibility		n between		n within the
			ECUs		implement-
			(Electronics		vehicle
			Control Unit)		combination
			of vehicle and		operate
			implement		successfully.
			defined?		
			Timing: At the		
			development		
			phase		
26	Speed of the	MET_TEC_IMP_01	Speed of the	Tow implements that need a	speed
20	UGV		UGV.	speed between 2km/h to 8	difference
	UGV			-	
			Timing: After	km/h.	<1km/h
			each field	Record speed use for each	
			operation	implement.	
				Record speed expectation for	
				this tool.	
				Record speed instruction	
				(speed set in the path planning	
				instructions).	
				[speed difference for each tool=	
				speed expectation- speed use]	
27	Precise height	MET_TEC_IMP_02	Mechanical	Mechanical weeding: Stabilize	<1 cm for both
	stabilisation		weeding tool	implements to a precise height	deviations
			pass depth.	regardless of the terrain.	
			Timing:	Pause the robot 3 times on	
			During a field	different location of the fields	
			operation - At	and record the tool pass depth	
			least twice per	in cm. Re do it 10 meters after	
			weeding	each pause.	
				Deviation of all the pass depths.	
			<u>season</u>	Deviation max of two	
				successive path depths.	
28	Implement	MET_TEC_IMP_08	Consumption	Record situations where the	Robotic
20					
	communicatio		of supply	robotic system can optimize its	system can
	n with robotic		sources.	consumption (energy or	optimize its
	platform /		Timing:	consumable).	consumption.
	activating		During field		
	supply sources		operation - At		
			least twice per		
			weeding		
			season		
		1		I	1

			1	-	,,
29	Production of ISOXML files to be sent to the FMIS	MET_TEC_IMP_10	Recording the as-applied information of field application and producing ISOXML file available on the ISOBUS terminal. <u>Timing:</u> <u>During each field application</u>	Acquisition of as-applied amount (Sprayer) together with geo-location of applied points.	To represent the behaviour of the implements during field application.
30	Full load tank autonomy	MET_TEC_IMP_11	Full load a tank. Record the time taken for it to empty during autonomous operations. <u>Timing:</u> <u>During a</u> <u>spraying</u> <u>operation - At</u> <u>least twice per</u> <u>weeding</u> <u>season</u>	The user can fill the tank of the sprayer during a mission to a full-load tank autonomy of 60 min.	Autonomy of 60 min minimum
		Fai	rming Controller 8	& FMIS	
31	Presentation of geospatial data	MET_TEC_F-C_15	Virtual map of the plot. <u>Timing: At the</u> <u>development</u> <u>phase.</u>	Is there a virtual map of the plot?	Presence of a virtual map of the plot usable during the operation for the end- user.
32	Communicatio n protocols between implements and the machinery established	MET_TEC_F-C_08	Is it possible to link implements and machinery such that they work together? <u>Timing: Once</u> <u>for each</u> implement.	Establish communication protocols in all levels: Use of ISOBUS or TCP/IP or other protocols to enable communication from the FC up to the implement/UGV. Count incidences where help of dealer / manufacturer is required to make the implement and UGV work with the FC.	No incidences.
33	Data retrieved from operations are properly displayed and understood	MET_TEC_F-C_06	End-users are able to find and understand the way the data is displayed.	Receive data from sensors: perception information from the field (examples: soil and weather conditions, 3D mapping of the field and the crops, GPS data for the position of the tractor, diesel level	The farmer is able to find and understand the information that is

			with 5 users each time.	remote supervision, camera data, etc.). Ask end-users a description of the information displayed. Ask them to find specific information (speed, position, progress of the mission etc.)	to make decisions from the information displayed (ex: if the diesel levels are low, then he can refill, etc.).
34	Input information of each UGV and implement in the FMIS.	MET_TEC_F-C_11	Ability to input information of each UGV and implement in the FMIS. <u>Timing: Once</u> for each robot and implement.	Store description of all robots and implements on the farm (include weight, size, working width, fuel autonomy, source of fuel, which connectors are available, etc.) Indicate the ability or non- ability. Define data size.	Yes.
35	Performance assessment visualisation.	MET_TEC_F-C_13	Efficiency of the user interface to visualize as- applied information and performance assessment. <u>Timing: Once</u> <u>a year.</u>	End user feedback with a 1 to 4 scale (Nothing wrong, Efficient, Not efficient, Unusable).	At least "Efficient" to "Nothing wrong"
36	User interface inputs task- related parameters	MET_TEC_F-C_14	Efficiency of the user interface to input task- related parameters. <u>Timing: Once</u> <u>a year.</u>	End user feedback with a 1 to 4 scale (Nothing wrong, Efficient, Not efficient, Unusable)	At least "Efficient" to "Nothing wrong"
37	Conditions to be met before execution of tasks	MET_TEC_F-C_01	Ability to input the conditions under which a task is performed into the robotic system. <u>Timing:</u> <u>Before</u> <u>starting fields</u> <u>operations -</u> <u>At least once</u> <u>per task</u>	Record if it is possible or not.	Yes, it is possible
38	Resources for the execution of tasks	MET_TEC_F-C_02	Ability to input the resources	Record if it is possible or not.	Yes, it is possible

			available or		
			not for each		
			task.		
			Timing:		
			Before		
			starting fields		
			operations -		
			At least once		
20	Country into our		per task	Description of the second state	
39	Constraints on	MET_TEC_F-C_03	Ability to	Record if it is possible or not.	Yes, it is
	when and		input time		possible
	how tasks		constrain for		
	should be		each task and		
	executed		to parameter		
			each task.		
			Timing:		
			Before		
			starting fields		
			operations -		
			At least once		
			per task		
40	Robot's	MET_TEC_F-C_04	Does the	Leave less fuel than the mission	>90%
	battery	·····_····	farmer get a	needs in the tank of the UGV.	2 5070
	notification		notification	Start the mission and record, if	
	notification				
			when the level	you are notified, whether you	
			of fuel is low	have time to stop the robot	
			and before it	before it stops by itself.	
			reaches 0?		
			<u>Timing:</u>	[ = Number of times the robot is	
			Timing: Before	refilled before it runs out of	
			starting fields	power / Number of tests of this	
			operations -	measure]	
			At least once		
			<u>per task</u>		
41	Precision of	MET_TEC_F-C_05	Reality of the	Have a digital copy of the field	At least
	the digital		сору.	in a virtual environment	"Similar" to
	twin of the		Timing:	alongside with the CAD files of	"exactly the
	field		<u>Before</u>	the used resources. This digital	same"
			starting	copy should be precise.	
			weeding	End user feedback with a 1 to 5	
			season and	scale (Exactly the same, strong	
			after weeding	likeness, similar, some defect,	
			season. At	not a copy)	
			least twice per		
			<u>year</u>		
42	FMIS provides	MET_TEC_F-C_07	Communicatio	Change a parameter in the FMIS	Communicatio
42	information		n between the	and record if it was changed in	n between the
				_	
			FC and the	the FC.	FC and the
	about the		ENAIS		
	about the needs of the		FMIS.		FMIS is
	about the		<u>Timing:</u>		FMIS is achieved.
	about the needs of the		<u>Timing:</u> <u>Before</u>		
	about the needs of the		<u>Timing:</u> <u>Before</u> <u>starting a field</u>		
	about the needs of the		Timing: Before starting a field operation - At		
	about the needs of the		Timing: Before starting a field operation - At least twice per		
	about the needs of the		Timing: Before starting a field operation - At		

43	Input task information in the FMIS.	MET_TEC_F-C_10	Ability to input information on each task in the FMIS. <u>Timing: Once</u> <u>a year - At</u> <u>least twice per</u> weeding	Store all field operations with related information (e.g., technical, financial, etc.) Indicate if it is possible or not to do it.	Yes.
			season.		
44	End-user's ability to intervene	MET_TEC_F-C_16	Can the end- user intervene at any time during an operation if the circumstances so require? <u>Timing: All</u> <u>along the</u> <u>process - At</u> <u>least twice per</u> <u>weeding</u> season.	Record case where the end user cannot intervene and what s/he would have done.	No cases occur.
45	Ability to pause and resume tasks.	MET_TEC_F-C_17	Can the operation be paused and resumed? <u>Timing:</u> <u>Before</u> <u>starting the</u> <u>weeding</u> <u>season.</u>	Record if the robotic system can be paused during its operation. Record if it can be resumed. Record the easiness of this process: End user feedback of their control of the robotic system with a 1 to 5 scale (very easy, easy, ok, difficult very difficult).	Both possible. At least "ok" to "very easy".
			NON-TECHNICAL		
			Safety		
46	Data security	MET_N-TEC_saf_03	Ensure that data cannot be improperly accessed or modified). <u>Timing: Once</u> <u>a year.</u>	Use an expert, like a data integrity expert, cloud security expert from one of the institutes to perform an integrity test (From the land survey to the robotic mission and data record by the robotic system in the field).	99% uptime guaranteed of the robot.
47	Compliance with Machine directive and the EU legislations	MET_N-TEC_saf_04	Check the list of standards and regulations collected in WP1 are compliant with the robotic system. <u>Timing: Once</u> <u>a year.</u>	Send list to robot supplier for verification that the standards are harmonized. Number of standards company is in compliance/not in compliance.	Robotic companies are in compliance with the required standards so the product can be CE marked.

		• • • • • · · · · · · ·			
48	Injuries and	MET_N-TEC_saf_01	Injuries to	Record the number of injuries	Injures
	danger		human or dangerous	suffer by a human and the number of injured humans.	≤2/season Danger ≤ 2
	created by the robot		situation	Record the number of	
	10001		created by the	dangerous situation (users	
			robotic	perspective when/if they have	
			system.	felt that the robot was unsafe	
			Timing: All	or if the robot would hurt	
			along the	them) and their level (Minor=	
			process –	No consequences, Significant =	
			when it	Minor injuries / Minor damages	
			happens.	of other equipment / Minor	
				damage of public or private	
				property / Temporary damage	
				to environment, Critical =	
				Temporary disability without	
				death threat / Temporary	
				professional disease / Serious injure / Loss or damaged of the	
				robotic system / Loss or big	
				damage of public or private	
				property / Long term damaged	
				to the environment ,	
				Catastrophic = Death / Death	
				threat / Permanent disability /	
				Professional diseases).	
				Injures = number of injures	
				× number of human injured	
				Danger=number of	
				dangerous situation×level	
				of the situation (1 for	
				minor-2 for significant-3	
				for Critical-4 for	
40	Compliance	MET NITEC and 02	Casas where	Catastrophic)	Zoro cococ
49	Compliance with local law	MET_N-TEC_saf_02	Cases where the robotic	Record case where the robotic system does not comply with	Zero cases.
	and regulation		system do not	the local law and regulation.	
	and regulation		comply with	Number of cases.	
			the local law		
			and		
			regulation.		
			Timing: All		
			along the		
			process –		
			<u>when it</u> happens.		
50	Possibility to	MET_N-TEC_saf_05	Can the final	Determine if the final user can	Able to
	monitor		user monitor	monitor parameters of the	monitor:
	implement		parameters	robotic system as a tractor	UGV: Speed,
	and robot's		that drives the	driver can.	chaining of
	functions		implement	Indicate number of parameters	row, height of
			and the	not monitored.	the implement
			robot's		etc.
			functioning as		Implement:
					height of the

				l	
			a tractor		implement,
			driver can?		adjustment
			Timing: All		etc.
			along the		
			process - At		
			least twice		
			each year		
			Labour	L	
51	Ability to keep	MET_N-TEC_lab_06	Is the FMIS	End user feedback with a 1 to 4	At least
-	inventory of		well construct	scale (Nothing wrong, Efficient,	"Efficient" to
	farm inputs		to keep the	Not efficient, Unusable)	"Nothing
			inventory of	Not emelent, onususiej	wrong"
			goods?		wrong
			-		
			Timing: Once		
			<u>a year</u>		
52	Capacity of	MET_N-TEC_lab_01	Capacity of an	End user feedback of their	End user
	the end-user		end-user to	control of the robotic system	feedback at
	to manage the		control the	with a 1 to 5 scale (very easy,	least "ok" to
	robotic		robotic	easy, ok, difficult very difficult)	"very easy"
	system		system with	and assessment by an	Experienced
			only a user's	experienced user of this control	user
			manual and a	(with the same 1 to 5 scale).	assessment at
			training.	· · · · · · · · · · · · · · · · · · ·	least "ok" to
			Timing: At		"very easy"
			least once per		veryeasy
53	Onon road		<u>season.</u> Can the	Record if no.	All Yes.
55	Open road	MET_N-TEC_lab_03			
	transport of		robotic	If yes, evaluate the	Easy to Ok
	the robotic		system (UGV +	maneuverability of your route	assessment
	system		Tools) be load	(Easy - Ok - Hard).	
			on a trailer or		
			within a van?		
			Timing: At		
			least once per		
			<u>season</u>		
54	Use of	MET_N-TEC_lab_04	The hardware	Indicate the tool needed to	No
	conventional		can be	maintain the robot or the	unconvention
	tools		maintained	implement	al tool is
			with	F	needed.
			conventional		
			tools that the		
			farmer uses.		
			Timing: All		
			along the		
			process – At		
			<u>each</u>		
			<u>maintenance</u>		
55	Feasibility of	MET_N-TEC_lab_05	Measure the	End user feedback with a 1 to 5	At least "not
	the workplan		feasibility of	scale (Perfect, Feasible easily,	that simple
			the workplan.	not that simple but feasible,	but feasible"
			Timing: At	Need few changes, Impossible)	to "Perfect".
			least once per		
			season		
			<u>season</u> Ethics		
56	Additional	MET N-	Ethics	The system should not	The use of the
56	Additional health risk	MET_N- TEC_Eth_03		The system should not invalidate the health insurance	The use of the robot doesn't

		I			
	and/or need		additional	of the people using it (high-risk	recommend a
	for additional		insurance?	sports such as sky diving require	supplementar
	insurance for		<ul> <li>Risk to user's</li> </ul>	additional insurance - we don't	y health
	the farmer		health and	want this for the R4C robotic	insurance.
			difficulty of	system).	
			work.	<ul> <li>Is an additional insurance</li> </ul>	
			<ul> <li>Time invested</li> </ul>	necessary?	
			in discussions	<ul> <li>Record time invested in</li> </ul>	
			with	discussions with insurance	
			insurance	companies.	
			companies.	<ul> <li>Record for each conventional</li> </ul>	
				and autonomous system: -	
			Timing:	Amounts and type of	
			Before	pesticides and herbicides	
			starting the	used.	
			field	- Number of operations that	
			operations –	may cause human exposure	
			when	to pesticides	
			discussing	- Number of operations that	
			with insurance	have a lower health risk	
			companies.	- Number of operations that	
			After each	have a higher health risk	
			season.	- Time of exposure: • To	
				pesticides • To tractor	
				vibration (with a	
				conventional system)	
				- Hours of physical work (with	
				both conventional and	
				autonomous system)	
57	Liability	MET_N-	Presence of a	The system should not	The use of the
	insurance of	TEC_Eth_04	health	invalidate the liability insurance	robot doesn't
	the testing		insurance of	of the property on which the	recommend a
	property		the operator	R4C robotic system is used.	supplementar
			Time invested	Indicate presence/absence of	y health
			from the end	health insurance.	insurance.
			user to		
			convince the		
			insurance		
			company.		
			<u>Timing:</u>		
			<u>Before</u>		
			starting the		
			· · ·		
			<u>field</u>		
			field operations -		
			operations -		
			operations - when		
			operations - when discussing with insurance companies.		
58	Farmer's	MET_N-	operations - when discussing with insurance	Farmer should be able to	Yes, the
58	Farmer's understanding	MET_N- TEC_Eth_01	operations - when discussing with insurance companies. Possibility to follow the FC	understand the decisions made	Yes, the farmer is able.
58		_	operations - when discussing with insurance companies. Possibility to	understand the decisions made by the system.	
58		_	operations - when discussing with insurance companies. Possibility to follow the FC decision. Timing:	understand the decisions made by the system. Record if it is possible and	
58		_	operations - when discussing with insurance companies. Possibility to follow the FC decision. Timing: Before	understand the decisions made by the system.	
58		_	operations - when discussing with insurance companies. Possibility to follow the FC decision. Timing:	understand the decisions made by the system. Record if it is possible and	

			least twice per		
59	Farmer's ability to intervene in the decision making	MET_N- TEC_Eth_02	season Ability to manually modified each decision of the FC. <u>Timing:</u> <u>Before</u> <u>starting a field</u> <u>operation - At</u> <u>least twice per</u> <u>season</u>	Farmer should be able to intervene in the decisions made by the system when needed. Record if it is possible or not.	Yes, the farmer is able.
60	Cost- effectiveness of the robotic system	MET_N- TEC_eco_01	Economics User time to prepare the robotic system and all economic aspects. <u>Timing:</u> • Regional data: Year 2. • All other metrics: Once each year - <u>Validation of the minimum</u> viable product.	For both conventional and autonomous system:• Time between starting the motor and the implement coupling to the robot.• Time between attaching the implements to the robot and the robot is attached on the transport• Time from the moment the transport arrived at the field to the moment when the transport leaves with the robot• Cost of the Land Survey • How many field operations are necessary to have a clean plot?• Fuel consumption per hectare • Quantity of pesticide and herbicides used• Type of pesticide and herbicides used• Yield• Cost of: - Herbicide – Fertilizer - Plant protection products - Fuel – Harvest• Fixed costs• Investments• Lifetime of investments• Current interest rate • Number of operations • Total spending per hectare with conventional system • Number of hectares that the robotic system can handle • Number of hectares of the farm• Data about the region: • Total Area (ha)	Be cost effective.

eographical relevance and
Indaries (e.g., Covered by
peratives, local region,
chment)
umber of farms within the
a, type of farmland (soil
e), crops produced, farm
s and structure, employees
umber of citizens
ata of ~100 Farmer:
ication, age, farm size and
e of farm and crops
duced, questions about
ners perception of various
onomous systems, needs,
riers, technical problems,
ed, risk, skills, convenience
ssess the number of jobs
t could be created in relation
Agri-and IT business
alysis:
me of the end user allocated
the task (weeding or
aying)
ost per hectare of the task
l-user feedback. The robotic Acceptable or
ition is: Not acceptable (no highly
ful outcome, easiness to acceptable.
, or benefit) – Acceptable
me benefit) - Highly
eptable (end-user identifies
n benefit from the use of the
ot)

## 2.3 Evaluation templates

In the following sections, the individual evaluation templates for the large-scale pilots are presented.

### 2.3.1 Evaluation template for LSP 1

#### LSP 1 - FRANCE - VINEYARD AND VEGETABLE MECHANICAL WEEDING WITH CEOL ROBOT

Name of the person reporting: Indicate your name

Organisation: Indicate your organisation

Day/Month/Year: Indicate date of reporting

Period of reporting: *Indicate the reporting period* 

This evaluation report serves the purpose of monitoring the timeline execution and KPIs of your LSP. Follow the guidelines provided in red "*Italic*" letters and fill in the whole report template. In case some KPIs or activities have not been measured/executed during the period of reporting, indicate the time you are planning to measure/execute them in the comments section (5th column). This evaluation report corresponds to the 3-year execution of your LPS, thus to the 3 minimum viable products of your robotic solution.

### TIMELINE MONITORING

	Expected timeline	Have you followed the expected timeline?	Are there any deviations from the expected timeline?	Comments about the execution of the timeline.
Сгор		YES/NO	YES/NO	<i>Give your comments about the activities conducted. Describe any possible deviations from the expected timeline and give a justification. Explain if these deviations impacted the monitoring of KPIs.</i>
	2021: Receipt and first technical tests			
Vineyards	March to July: Six (6) passes with three (3) tools in three (3) fields with 2 to 3 weeks between each pass.			
	October to December: Preparation of the robotic passages (land survey as example), plus co-design session.			
	<b>2022: Preparation</b> Testing the robotic solution with two (2)			

farmers on their farms, two (2) fields for R&D tests, one (1) co-design session and a few demonstrations of the robotic system. January: Receival of robot. Update of the robots already there. February: One (1) pass with a tool to de-earth (with a tractor if not possible with CEOL) March to July: Six (6) passes with 1/2 weeks between each pass. Measurements and Validation. At the end of each pass debrief will be done to decide if adaptations are needed / Test of new tools in the R&D fields / Adaptation between each pass during the "free" week. (Co-design session?) July to August: Validations and preparation for the next year. October to December: One (1) pass with disks harrow to earth-up and preparation of the robotic solution with 4 farmers on their farms, plus two (2) fields for R&O test, one (1) co- design session. 2023: "Industrialization" of the procedure: Test the robotic system to everybody asking. Same process as 2022 2024: Commercialization on Large Scale: Test the robotic solution with			
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Same process as 2022         2024:         Commercialization on         Large Scale: Test the	,		
2024: Commercialization on Large Scale: Test the			
Commercialization on Large Scale: Test the			
Large Scale: Test the			
robotic solution with	-		
	robotic solution with		

	ten (10) famers (~100		
	ha) on their farms, plus		
	two (2) for R&D test,		
	one (1) co-design		
	session and		
	demonstrations of the		
	robotic system to		
	everybody asking.		
	Same process as 2022		
	2022: Receival and first		
	technical tests / test		
	the robotic solution		
	with one (1) farmer on		
	one (1) or two (2) strips		
	vegetable, plus one (1)		
	co-design session.		
	January-April:		
	Receival of the robotic		
	system. Preparation of		
	the robotic passages		
	(land survey as		
	example).		
	April-May ??: Test		
	of the robotic solution.		
	Measurements and		
	Validation. Adaptation		
	between each pass		
	during the "free" week.		
	Co-design-session		
	2023: Preparation of		
Vegetable	the procedures.		
Vegetable	Testing of the robotic		
	solution (on a different		
	crop?) with another		
	farmer. Continue to		
	test the robotic		
	solution with one (1)		
	farmer on one (1) or		
	more strips vegetable.		
	Co-design session.		
	Same process as 2022		
	2024:		
	"Industrialization" of		
	the procedure. Testing		
	the robotic solution		
	with a 3rd farmer.		
	Continue to test the		
	robotic solution with		
	the two (2) other		
	farmers on a few		
	hectares. Co-design		
	session.		
	Same process as 2023		
	June process as 2023		

	KPI MONITORING					
KPI No.	KPI title	When did you measure?	What did you measure? How did you measure it?	Do you have any comments to add about your measurement?		
		Indicate specific time of measurement (day/month/year). Indicate all repeated measurements in case a measurement is conducted multiple times.	Describe briefly the measurement you conducted.	Have you accomplished the measurement as described in the evaluation methodology? What was the outcome? Have you achieved the target?		
	Plant dagamo/	AGRON	NOMIC KPIs			
1	Plant dagame/ destruction					
2	Agronomic performance of the robot					
			NICAL KPIs ound Vehicle (UGV)			
3	Size of robot suitable for	Onmanned Gr	ound venicle (UGV)			
	different crops					
4	Hardware present and operational					
5	Electrical, hydraulic and PTO output to the implement					
6	Robotics platform regroups the data to communicate with the user					
7 8	3-point hitch AB lines import from GNSS system					
9	Performing in wet clay soil					
10	Performing in terrain slopes					
11	Obstacle detection					
12	Autonomy of the whole robotic system					

13	Use of common		[			
13	implements					
14	Teach in					
15	Human					
	intervention in					
	robotic work					
16	Farmer					
	competences					
	for using the					
	robot					
17	Deviation of					
	the trajectory					
	of the towing					
	system.					
18	Capacity of robot and					
	robot and tractor to work					
	under different					
	conditions					
19	Blockage					
	detection and					
	rectification					
20	Equipment					
	breakdown.					
	Reliability of					
	the UGV.					
21	UGV works in					
	low					
22	temperatures UGV works in					
22	high					
	temperatures					
23	Improvement					
	ofguidance					
	and U-turn of					
	the UGV					
24	Level of system					
	deterioration					
	due to weather					
25	Trajectory					
	optimisation/ Reduction of					
	pass overs Implements					
26	Speed of the					
	UGV					
27	Precise height					
	stabilisation					
28	Implement					
	communication					
	with robotic					
	platform /					
	activating					
	supply sources					

Farming Controller & FMIS							
29	Presentation of						
	geospatial data						
30	Communication						
	protocols						
	between						
	implements						
	and the						
	machinery						
31	established Data retrieved						
51	from						
	operations are						
	properly						
	displayed and						
	understood						
32	Autonomous						
	response of the						
	robotic system						
	to unforeseen						
	events.						
33	Input information of						
	each UGV and						
	implement in						
	the FMIS.						
34	Performance						
	assessment						
	visualisation.						
35	User interface						
	inputs task-						
	related						
36	parameters Conditions to						
50	be met before						
	execution of						
	tasks						
37	Resources for						
	the execution						
	oftasks						
38	Constraints on						
	when and how						
1	tasks should be						
	executed						
39	Robot's battery notification						
40	Precision of the						
	digital twin of						
1	the field						
41	FMIS provides						
1	information						
1	about the						
1	needs of the						
	сгорѕ						

			1	
42	Input task			
	information in			
	the FMIS.			
43	End-user's			
	ability to			
	intervene			
44				
44	Ability to pause and resume			
	tasks.			
			CHNICAL KPIs	
		5	afety	
45	Data security			
46	Compliance			
	with Machine			
	directive and			
	the EU			
	legislations			
47	Injuries and			
	danger created			
	by the robot			
48	Compliance			
70	with local law			
(10)	and regulation			
49	Possibility to			
	monitor			
	implement and			
	roboťs			
	functions			
		L	abour	
50	Ability to keep			
	inventory of			
	farm inputs			
51	Capacity of the			
	end-user to			
	manage the			
	robotic system			
52	Open road			
	transport of			
	the robotic			
	system			
53	Use of			
	conventional			
	tools			
54	Feasibility of			
57	the workplan			
			Ethics	
55	Additional			
55	health risk			
	and/or need for			
	additional			
	insurance for			
	the farmer			
56	Liability			
	insurance of			

	the testing				
	property				
57	Farmer's				
	understanding				
58	Farmer's ability				
	to intervene in				
	the decision				
	making		_		
				onomics	
	Cost-effectivene	ess of	the robotic syste	י <b>ח</b> י.	
	For both				
	conventional				
59	and autonomous				
	system Data about the				
	region				
	Тедіон		(	Social	
	Social				
60	acceptance				
				BLE PRODUCT (MVP)	
		Ρгο	vide an overall ev	aluation summary of	your MVP, based KPI
					r solution? Is there room for
				ir solution useful and	cost-beneficial? Include
		pho	tos of your MVP.		
	MVP 1				
	MVP 2				
	MVP 3				
	SUMMARY ASSESSMENT FROM THE FOCUS GROUP				
				ovide a summary of th Il as the minimum via	ne FG's assessment of annual
	MVP 1		activities, as we	יו פא נוופ וווווווווווווווווווווווווווווו	
	MVP 2				
	MVP 3				
1					

### 2.3.2 Evaluation template for LSP 2

# LSP 2 – GREECE – CEOL AND RETROFITTED TRACTOR FOR SPRAYING OPERATIONS ON TABLE GRAPES Name of the person reporting: *Indicate your name*

Organisation: Indicate your organisation

Day/Month/Year: Indicate date of reporting

Period of reporting: *Indicate the reporting period* 

This evaluation report serves the purpose of monitoring the timeline execution and KPIs of your LSP. Follow the guidelines provided in red "*Italic*" letters and fill in the whole report template. In case some KPIs or activities have not been measured/executed during the period of reporting, indicate the time you are planning to measure/execute them in the comments

section (5th column). This evaluation report corresponds to the 3-year execution of your LPS, thus to the 3 minimum viable products of your robotic solution.								
	TIMELINE MONITORING							
		Have you followed the expected timeline?	Are there any deviations from the expected timeline?	Comments about the execution of the timeline.				
Expected timeline	Expected activities	YES/NO	YES/NO	Give your comments about the activities conducted. Describe any possible deviations from the expected timeline and give a justification. Explain if these deviations impacted the monitoring of KPIs.				
Start to February 2022	Preparations: Measurements, Farm Dimensions, Photos', Purchase							
	of tractor, Robot set up.							
February – September 2022	Robot Implementation and observation of method during cultivation							
October 2022- January 2023	Analyse data and make necessary adjustment, if needed.							
February – September 2023	Robot Implementation and observation of method during cultivation.							
October 2023- January 2024	Analyse data and make necessary adjustment if needed.							
February – September 2024	Robot implementation and observation of method during cultivation.							
October 2024- January 2025	Analyse data and make necessary adjustment if needed. End of project							

	Which of the following pests and malnutritions have you treated during the execution of the LSP?					
	Period	Pes	ts and malnutricions (sele	ect from below)	Comments	
	Indicate one or more pests and malnutricions treated for each period: • Powdery & downy Mildew • Botrytis • Grineria • Lobesia botrana • Thrips • Plannoccus • Malnutrition Zn, Fe, K			Please, provide any additional comments about the treatments.		
Star						
	uary 2022					
	uary – ember o					
	- ber 2022-					
	iary 2023					
	uary –					
	ember					
2023 Octo	3 ber 2023-					
	lary 2024					
	February –					
	ember					
2024						
	ber 2024- Iary 2025					
			KPI MON	ITORING		
KPI No.	KPI title	•	When did you measure?	What did you measure? How did you measure it?	Do you have any comments to add about your measurement?	
			Indicate specific time of measurement (day/month/year). Indicate all repeated measurements in case a measurement is conducted multiple times.	<i>Describe briefly the measurement you conducted.</i>	Have you accomplished the measurement as described in the evaluation methodology? What was the outcome? Have you achieved the target?	
1	Plant damaged destruction					
2	Agronomic performanc the robot					
			TECHNIC			
			Unmanned Grou	nd Vehicle (UGV)		

з	Size of robot		
	suitable for		
	different crops		
4	Hardware		
	present and		
	operational		
5	Electrical,		
5	hydraulic and		
	PTO output to		
	the implement		
-	Robotics		
6			
	platform		
	regroups the		
	data to		
	communicate		
	with the user		
7	3-point hitch		
8	AB lines import		
	from GNSS		
	system		
9	Performing in		
	wet clay soil		
10	Autonomy of		
	the whole		
	robotic system		
11	Teach in		
12	Human		
	intervention in		
	robotic work		
13	Farmer		
	competences		
	for using the		
	robot		
14	Deviation of		
	the trajectory		
	of the towing		
	system.		
15	Capacity of		
	robot and		
	tractor to work		
	under different		
	conditions		
16	Equipment		
10	breakdown.		
	Reliability of		
	the UGV.		
17	UGV works in		
	low		
	temperatures		
18	UGV works in		
	high		
	temperatures		
19	Improvement		
L			

	of guidance			
	and U-turn of			
	the UGV			
20	Level of system			
20	deterioration			
	due to weather			
21				
21	Trajectory			
	optimisation/			
	Reduction of			
	pass overs			
22	Correct			
	calculation of			
	the tank			
	гезегvе			
		Implen	nents	
23	Implement's			
	ISOBUS			
	compatibility			
24	Speed of the			
24	UGV			
25				
25	Spraying			
	coverage			
26	Detection of			
	nozzle			
	obstruction			
27	Automated			
	cleaning and			
	maintenance			
28	Implement			
	communication			
	with robotic			
	platform /			
	activating			
	supply sources			
29	Production of			
29	ISOXML files to			
	be sent to the			
	FMIS			
30	Full load tank			
	autonomy			
		Farming Cont	roller & FMIS	
31	Presentation of			
	geospatial data			
32	Communication			
	protocols			
1	between			
	implements			
1	and the			
1	machinery			
1	established			
33	Data retrieved			
55	from			
	operations are			
	properly			

			1	
	displayed and understood			
34	Input information of each UGV and implement in the FMIS.			
35	Prescription map for field operation			
36	Performance assessment visualisation.			
37	User interface inputs task- related parameters			
38	Conditions to be met before execution of tasks			
39	Resources for the execution of tasks			
40	Constraints on when and how tasks should be executed			
41	Robot's battery notification			
42	Precision of the digital twin of the field			
43	FMIS provides information about the needs of the crops			
44	Input task information in the FMIS.			
45	End-user's ability to intervene			
46	Ability to pause and resume tasks.			
		NON-TECH		
		Safe	ety	
47 48	Data security Compliance with Machine			
	directive and	l		

				1 1			
	the EU						
	legislations						
49	Injuries and						
	danger created						
	by the robot						
50	Compliance						
50	with local law						
	and regulation						
		Lab	DUL				
51	Ability to keep						
	inventory of						
	farm inputs						
52	Capacity of the						
	end-user to						
	manage the						
	robotic system						
53							
55	Launching a mission in field						
54	Open road						
	transport of						
	the robotic						
	system						
55	Use of						
	conventional						
	tools						
56	Feasibility of						
	the workplan						
		Eth	ics				
57	Additional	Eth	ics				
57	Additional	Eth	ics				
57	health risk	Eth	ics				
57	health risk and/or need for	Eth	ics				
57	health risk and/or need for additional	Eth	ics				
57	health risk and/or need for additional insurance for	Eth	ics				
	health risk and/or need for additional insurance for the farmer	Eth	ics				
57	health risk and/or need for additional insurance for the farmer Liability	Eth	ics				
	health risk and/or need for additional insurance for the farmer	Eth	ics				
	health risk and/or need for additional insurance for the farmer Liability	Eth	ics				
	health risk and/or need for additional insurance for the farmer Liability insurance of the testing	Eth	ics				
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property	Eth	ics				
	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's	Eth	ics				
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding	Eth	ics				
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability	Eth	ics				
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in	Eth					
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision	Eth	ics				
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in						
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making	Econc					
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene						
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene For both	Econc					
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene For both conventional	Econc					
58 59 60	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene For both	Econc					
58	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene For both conventional	Econc					
58 59 60	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene For both conventional and autonomous	Econc					
58 59 60	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene For both conventional and autonomous system	Econc					
58 59 60	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene For both conventional and autonomous system Data about the	Econc					
58 59 60	health risk and/or need for additional insurance for the farmer Liability insurance of the testing property Farmer's understanding Farmer's ability to intervene in the decision making Cost-effectivene For both conventional and autonomous system	Econc	mics				

62	Social acceptance				
			MINIMUM VIABLE PRODUCT (MVP)		
	Provide an overall evaluation summary of your MVP, based KPI monitoring. What are the benefits of your solution? Is there room for improvement? Is your solution useful and cost-beneficial? Include photos of your MVP.				
	MVP 1				
	MVP 2				
	MVP 3				
		SUM	NARY ASSESSMENT FROM THE FOCUS GROUP		
			<i>Here, please provide a summary of the FG's assessment of annual activities, as well as the minimum viable product.</i>		
	MVP 1				
	MVP 2				
	MVP 3				

# 2.3.3 Evaluation template for LSP 3

LSP 3 – SPAIN – APPLE ORCHARDS SPRAYING WITH RETROFITTED TRACTOR

Name of the person reporting: *Indicate your name* 

Organisation: Indicate your organisation

Day/Month/Year: Indicate date of reporting

Period of reporting: *Indicate the reporting period* 

This evaluation report serves the purpose of monitoring the timeline execution and KPIs of your LSP. Follow the guidelines provided in red *"Italic"* letters and fill in the whole report template. In case some KPIs or activities have not been measured/executed during the period of reporting, indicate the time you are planning to measure/execute them in the comments section (5th column). This evaluation report corresponds to the 3-year execution of your LPS, thus to the 3 minimum viable products of your robotic solution.

TIMELINE MONITORING						
		Have you followed the expected timeline?	Are there any deviations from the expected timeline?	Comments about the execution of the timeline.		
Expected timeline	Expected activities	YES/NO	YES/NO	Give your comments about the activities conducted. Describe any possible deviations from the expected timeline and give a justification. Explain if these deviations impacted the monitoring of KPIs.		

Start to	Preparations:						
February 2022	Measurements,						
	Farm Dimensions,						
	Photos', Purchase						
	of tractor, Robot						
	set up.						
February –	Robot						
September	Implementation						
2022	and observation						
	of method during						
	cultivation						
October 2022-	Analyse data and						
January 2023	make necessary						
	adjustment, if						
	needed.						
February –	Robot						
September	Implementation						
2023	and observation						
	of method during						
	cultivation.						
October 2023-	Analyse data and						
January 2024	make necessary						
	adjustment if						
	needed.						
February –	Robot						
September	implementation						
2024	and observation						
	of method during						
	cultivation.						
October 2024-	Analyse data and						
January 2025	make necessary						
	adjustment if						
	needed. End of						
	project						
Which of the follo	owing measurements	have you cor	nducted durir	ng the execution of the LSP?			
Design	0.0		halawa	Concepts			
Period	Measurement	s (select from	Delow)	Comments			
	Indicate one or more						
	measurements you		ıring the				
	execution of your L			Please, provide any			
	product qual			additional comments about			
	<ul> <li>mist-blower</li> </ul>			the activities.			
		between tra					
1							
	treatments a	and automatic	treatments				
		and automatic					
Start to		and automatic					
February 2022		and automatic					
February 2022 February –		and automatio					
February 2022 February – September		and automatio					
February 2022 February – September 2022		and automatio					
February 2022 February – September		and automatio					

Sept 2023 Octo Janu Febr Sept 2024 Octo	ber 2023- Jary 2024 Jary – Tember		KPI MON	ITORING	
				1	
KPI No.	KPI title		When did you measure?	What did you measure? How did you measure it?	Do you have any comments to add about your measurement?
			Indicate specific time of measurement (day/month/year). Indicate all repeated measurements in case a measurement is conducted multiple times.	Describe briefly the measurement you conducted.	Have you accomplished the measurement as described in the evaluation methodology? What was the outcome? Have you achieved the target?
1	Plant damaged destruction				
2	Agronomic performanc the robot	e of			
			TECHNIC		
_	Cies of each a	<b>_</b>	Unmanned Grou	nd Vehicle (UGV)	
3	Size of robo suitable for different cr				
4	Hardware present and operational				
5	Electrical, hydraulic ar PTO output the impleme	to			
6	Robotics platform regroups th data to communica with the use	te			
7	3-point hitc	:h			
8	AB lines imp from GNSS system	ort			
9	Performing wet clay soi				

-		<b></b>		r
10	Autonomy of			
	the whole			
	robotic system			
11	Teach in			
12	Human			
	intervention in			
	robotic work			
13	Farmer			
15				
	competences			
	for using the			
	robot			
14	Deviation of			
	the trajectory			
	of the towing			
	system.			
15	Obstacle			
	detection and			
	avoidance			
16	Capacity of			
	robot and			
	tractor to work			
	under different			
	conditions			
17	Equipment			
.,	breakdown.			
	Reliability of			
	the UGV.			
18	UGV works in			
10	low			
	temperatures			
19	UGV works in			
	high			
- 20	temperatures			
20	Improvement			
	of guidance			
	and U-turn of			
	the UGV			
21	Level of system			
	deterioration			
	due to weather			
22	Trajectory			
	optimisation/			
	Reduction of			
	pass overs			
23	Correct			
	calculation of			
	the tank			
	reserve			
		Implen	nents	
24	Implement's			
	ISOBUS			
	compatibility			
L		·	1	1

			1	
25	Speed of the UGV			
26	Spraying coverage			
27	Detection of			
	nozzle			
	obstruction			
28	Automated	-		
	cleaning and			
	maintenance			
29	Implement			
	communication			
	with robotic			
	platform /			
	activating			
	supply sources			
30	Production of			
	ISOXML files to be sent to the			
	FMIS			
31	Full load tank			
51	autonomy			
	deconomy	Farming Cont	roller & FMIS	
32	Presentation of			
	geospatial data			
33	Communication			
	protocols			
	between			
	implements			
	and the			
	machinery			
	established			
34	Data retrieved			
	from			
	operations are			
	properly displayed and			
	understood			
35	Autonomy to			
	respond to			
	unforeseen			
	events			
36	Input			
	information of			
	each UGV and			
	implement in			
	the FMIS.			
37	Prescription			
	map for field			
38	operation Performance			
50	assessment			
	visualisation.			
	sistansation.		1	

39User interface input task- related parametersImage: second				1	
related parametersrelated parametersrelated parameters40Conditions to be met before execution of tasksImage: Second Se	39	User interface			
related parametersrelated parametersrelated parameters40Conditions to be met before execution of tasksImage: Second Se		inputs task-			
parametersoneoneone40Conditions to be met before execution of tasksImage: Second Secon		•			
40       Conditions to be met before execution of tasks       Image: Constraints on weak of the execution of tasks         41       Resources for the execution of tasks       Image: Constraints on weak of the execution of tasks         42       Constraints on weak of the execution of tasks       Image: Constraints on weak of the executed         43       Robot's battery of tasks       Image: Constraints on weak of the digital twin of the field         43       Robot's battery of the digital twin of the field       Image: Constraints on weak of the constraints on about the needs of the constraints on the FANIS.       Image: Constraints on the field         46       Input task       Image: Constraints on the field       Image: Constraints on the field         47       End-user's and field       Image: Constraints on the field       Image: Constraints on the field         48       Ability to pause and resume tasks.       Image: Constraints on the field       Image: Constraints on the field         49       Data security       Image: Constraints on the field       Image: Constraints on the field         50       Compliance with Machine directive and the EU legislations       Image: Constraints on the field       Image: Constraints on the field         51       Injuries and dange created by the robot       Image: Constraints on the field       Image: Constraints					
be met before execution of tasksend low comparison when and how tasks should be executedend low comparison when and how tasks should be executedend low comparison comparisonend low comparison comparison42Constraints on when and how tasks should be executedImage: Comparison comparisonImage: Comparison comparison43Robot's battery notificationImage: Comparison comparisonImage: Comparison comparison44Precision of the digital twin of the fieldImage: Comparison comparison about the needs of the cropsImage: Comparison comparison45FAMIS provides information about the needs of the cropsImage: Comparison comparisonImage: Comparison comparison46Input task information in the FAMIS.Image: Comparison comparisonImage: Comparison comparison47End-user's ability to interveneImage: Comparison comparisonImage: Comparison comparison48Ability to pause and resume tasks.Image: Comparison comparisonImage: Comparison comparison50Compliance with Machine denger created by the robotImage: Comparison comparisonImage: Comparison comparison51Injuries and danger created by the robotImage: Comparison comparisonImage: Comparison comparison52Compliance with local law and regulationImage: Comparison comparisonImage: Comparison comparison53Possibility to implement and robot'sIm	/10	•			
execution of tasksexecution of tasksexecution of tasks41Resources for the execution of tasksImage: Constraints on when and how tasks should be executedImage: Constraints on when and how tasks should be executed42Constraints on when and how tasks should be executedImage: Constraints on tasks should be executed43Robot's battery notificationImage: Constraints on tasks should be executed44Precision of the digital twin of the fieldImage: Constraints on tasks45FMIS provides information about the needs of the cropsImage: Constraints on tasks46Input task information in the FMIS.Image: Constraints on tasks47End-user's ability to interveneImage: Constraints on tasks.48Ability to pause and resultImage: Constraints on tasks.50Compliance with Machine degree readedImage: Constraints on tasks.51Injuries and danger created by the robotImage: Constraints on tasks.53Possibility to implement and robot'sImage: Constraints on tasks.	-0				
tasksendend41Resources for the execution of tasksImage: Security of tasksImage: Security of tasks42Constraints on when and how tasks should be executedImage: Security of tasksImage: Security of tasks43Robot's battery notificationImage: Security of the digital twin of the fieldImage: Security of the of the digital twin of the fieldImage: Security of the of the digital twin of the field44Precision of the digital twin of the fieldImage: Security of the the fieldImage: Security of the security to pause and the securityImage: Security of the security45End-user's ability to interveneImage: Security securityImage: Security security46Information in the FMIS.Image: Security securityImage: Security security47End-user's ability to pause and resume tasks.Image: Security securityImage: Security security49Data security directive and the EU legislationsImage: Security securityImage: Security security51Injuries and danger created with local law and regulationImage: Security securityImage: Security security52Compliance with local law and regulationImage: Security securityImage: Security security53Possibility to pauseImage: Security securityImage: Security security53Possibility to pauseImage: Security security <th></th> <th></th> <th></th> <th></th> <th></th>					
41       Resources for the execution of tasks       Image: Second Secon					
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53 Possibility to monitor implement and robot's					
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implement and robot's					
robot's					
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		TUNCTIONS			

		Lab	оиг	
54	Ability to keep			
	inventory of			
	farm inputs			
55	Capacity of the			
	end-user to			
	manage the			
	robotic system			
56	Launching a			
	mission in field			
57	Open road			
	transport of			
	the robotic			
50	system			
58	Use of			
	conventional tools			
59	Feasibility of			
55	the workplan			
		Eth	ics	
60	Additional			
00	health risk			
	and/or need for			
	additional			
	insurance for			
	the farmer			
61	Liability			
	insurance of			
	the testing			
	property			
62	Farmer's			
	understanding			
63	Farmer's ability to intervene in			
	the decision			
	making	Econo	mice	
	Cost-offectivene	ss of the robotic system		
	For both	ss of the fobolic system		
	conventional			
	and			
64	autonomous			
	system			
	, Data about the			
	region			
		Soc	ial	
65	Social acceptance			
			E PRODUCT (MVP)	
		Provide an overall eval	luation summary o	f vour MVP, based KPI
				ir solution? Is there room
		for improvement? Is ye		
	Include photos of your MVP.			

MVP 1	
MVP 2	
MVP 3	
S	UMMARY ASSESSMENT FROM THE FOCUS GROUP
	Here, please provide a summary of the FG's assessment of annual activities, as well as the minimum viable product.
MVP 1	
MVP 2	
MVP 3	

### 2.3.4 Evaluation template for LSP 4

#### LSP 4 – THE NETHERLANDS – MECHANICAL WEEDING WITH ROBOTTI

Name of the person reporting: *Indicate your name* 

Organisation: Indicate your organisation

Day/Month/Year: Indicate date of reporting

Period of reporting: *Indicate the reporting period* 

This evaluation report serves the purpose of monitoring the timeline execution and KPIs of your LSP. Follow the guidelines provided in red "*Italic*" letters and fill in the whole report template. In case some KPIs or activities have not been measured/executed during the period of reporting, indicate the time you are planning to measure/execute them in the comments section (5th column). This evaluation report corresponds to the 3-year execution of your LPS, thus to the 3 minimum viable products of your robotic solution.

	TIMELI		ING	
		Have you followed the expected timeline?	Are there any deviations from the expected timeline?	Comments about the execution of the timeline.
Expected timeline	Expected activities	YES/NO	YES/NO	Give your comments about the activities conducted. Describe any possible deviations from the expected timeline and give a justification. Explain if these deviations impacted the monitoring of KPIs.
Start to April 2021	PreparationLSP4:Location'scheck,measurementscheck,map out our needs.			
May 2021 – October 2021	Fieldwork LSP4: Perform field work, measure			

Г				
	variables, adjusting when			
	necessary.			
	Measurements:			
November 2021 –	processing all data and			
December 2021	measurements, analyse			
	data, make conclusion.			
	Preparations LSP4:			
Januari 2022 –	Searching location,			
March 2022	measurements check,			
	map out our needs			
	Fieldwork LSP4: Perform			
April 2022 –	field work, measure			
October 2022	variables, adjust			
	implements.			
	Measurements:			
November 2022 –	processing all data and			
December 2022	measurements, analyse			
	data, make conclusion.			
	Preparations LSP4:			
Januari 2023 –	Searching location,			
March 2023	measurements check,			
	map out our needs.			
	Fieldwork LSP4: Perform			
April 2023 –	field work, measure			
October 2023	variables, adjust			
	implements.			
	Measurements:			
November 2023 –	processing all data and			
December 2023	measurements, analyse			
	data, make conclusion.			
	Preparations LSP4:			
Januari 2024 –	Searching location,			
March 2024	measurements check,			
	map out our needs.			
	Fieldwork LSP4: Perform			
April 2024 –	field work, measure			
October 2024	variables, adjust			
	implements.			
	Measurements:			
	processing all data and			
November 2024 –	measurements, analyse			
December 2024	data, finishing all data we			
	have.			
Which of the follo	owing measurements have	e you conduc	ted during t	ne execution of the LSP?
Period	Measurements (se	elect from be	low)	Comments
	Indicate one or more of t	he following		Please, provide any
	measurements you cond		the	additional comments
	execution of your LSP:			about the activities.

Novem Decem Januar March April 2 Octobe Novem Decem Januar March April 2 Octobe Novem Decem	021 - er 2021 hber 2021 - hber 2021 - i 2022 - 2022 022 - er 2022 hber 2022 - hber 2022 - i 2023 - 2023 023 - er 2023 hber 2023 - hber 2023 - hber 2023 - hber 2023 -	ha • Ra si • Ei • Do da • Ri m • So (h ba • H.	uel consumption (fuel purs/hectare) emote control (time w gnals) fficiency (hectares per epth how many % goe epth) ight spot for seeding rum ow many % is seeded andage) itting Crops for row cl ow many crops are his	ithout warning hours) es on the right mission (how t spot) ppkin mission in square eaner mission	
April 2					
	er 2024 nber 2024 –				
	iber 2024 – Iber 2024				
			KPI MONIT	ORING	
				What did you	
KPI No.	KPI t	itle	When did you measure?	measure? How did you measure it?	Do you have any comments to add about your measurement?
			Indicate specific time of measurement (day/month/year). Indicate all repeated measurements in case a	Describe briefly the measurement you conducted.	Have you accomplished the measurement as described in the evaluation methodology? What was the outcome? Have you achieved the target?

		measurement is		
		conducted multiple		
		times.		
		AGRONOM	IC KPIs	
1	Plant dagame/ destruction			
2	Dirty crops			
-	Agronomic			
з	performance of			
2	the robot			
		TECHNICA		
		Unmanned Ground		
4	Size of robot	Offiniarined droam		
	suitable for			
	different crops			
5	Hardware present			
	and operational			
6	Electrical,			
	hydraulic and PTO			
	output to the			
	implement			
7	Robotics platform			
<b>'</b>	regroups the data			
	to communicate			
	with the user			
8 9	3-point hitch AB lines import			
9				
10	from GNSS system Performing in wet			
10	clay soil			
11	Autonomy of the			
	whole robotic			
	system			
12	Use of common			
12	implements			
13	Teach in			
14	Human			
' 4	intervention in			
	robotic work			
15	Farmer			
15	competences for			
	using the robot			
	using the robot			
16	Deviation of the			
	trajectory of the			
	towing system.			
17	Capacity of robot			
	and tractor to			
	work under			
	different			
	conditions			
18	Blockage			
	detection and			
	rectification			
L		1	1	1

			I	1
19	Equipment			
	breakdown.			
	Reliability of the			
	, UGV.			
20	UGV works in low			
	temperatures			
21	UGV works in high			
	temperatures			
22	Improvement			
	of guidance and U-			
	turn of the UGV			
23	Level of system			
	deterioration due			
	to weather			
24	Trajectory			
	optimisation/			
	Reduction of pass			
	overs			
	overs	Implem	ants	
25	Implement's	implem		
	ISOBUS			
	compatibility			
26	Speed of the UGV			
20	Precise height			
21	stabilisation			
28				
20	Implement communication			
	with robotic			
	platform /			
	activating supply			
	sources			
29	Production of			
29	ISOXML files to be			
	sent to the FMIS			
30	Full load tank			
50				
	autonomy	Farming Contro		
31	Presentation of	Parming contro		
51	geospatial data			
32	Communication			
52				
	protocols between			
	implements and			
	the machinery			
	established			
33	Data retrieved			
	from operations			
	are properly			
	displayed and			
	understood			
34	Input information			
	of each UGV and			
	implement in the FMIS.			
			i de la companya de la company	

35 Performance assessment visualisation.	
visualisation.	
36 User interface	
inputs task-	
related	
parameters	
37 Conditions to be	
met before	
execution of tasks	
38 Resources for the	
execution of tasks	
39 Constraints on	
when and how	
tasks should be	
executed	
40 Robot's battery	
notification	
41 Precision of the	
digital twin of the	
field	
42 FMIS provides	
information about	
the needs of the	
сгоря	
43 Input task	
information in the	
FMIS.	
44 End-user's ability	
to intervene	
45 Ability to pause	
and resume tasks.	
NON-TECHNICAL KPIs	
Safety	
46 Data security	
Machine directive	
and the EU	
legislations	
48 Injuries and	
danger created by	
the robot	
49 Compliance with	
local law and	
regulation	
50 Possibility to	
monitor	
implement and	
robot's functions	
Labour	
Labour Labour	
Labour	

52	Capacity of the			
	end-user to			
	manage the			
	robotic system			
53	Open road			
	transport of the			
	robotic system			
54	Use of			
	conventional tools			
55	Feasibility of the			
	workplan			
		Ethio	s	
56	Additional health			
	risk and/or need			
	for additional			
	insurance for the			
	farmer			
57	Liability insurance			
	of the testing			
	property			
58	Farmer's			
	understanding			
59	Farmer's ability to			
	intervene in the			
	decision making			
		Econor	nics	
		of the robotic system	1	
	For both	of the robotic system		
60	For both conventional and	of the robotic system		
60	For both conventional and autonomous	of the robotic system		
60	For both conventional and autonomous system	of the robotic system		
60	For both conventional and autonomous system Data about the	of the robotic system		
60	For both conventional and autonomous system			
	For both conventional and autonomous system Data about the region	of the robotic system Soci	al	
60	For both conventional and autonomous system Data about the	Soci		
	For both conventional and autonomous system Data about the region			
	For both conventional and autonomous system Data about the region	Soci MINIMUM VIABLE	PRODUCT (MVP)	of your MVP, based KPI
	For both conventional and autonomous system Data about the region	Soci MINIMUM VIABLE <i>Provide an overall e</i>	PRODUCT (MVP) valuation summary	of your MVP, based KPI pur solution? Is there
	For both conventional and autonomous system Data about the region	Soci MINIMUM VIABLE <i>Provide an overall e</i>	PRODUCT (MVP) valuation summary re the benefits of yo	our solution? Is there
	For both conventional and autonomous system Data about the region	Soci MINIMUM VIABLE Provide an overall e monitoring. What a	PRODUCT (MVP) valuation summary re the benefits of yo ent? Is your solution	our solution? Is there a useful and cost-
	For both conventional and autonomous system Data about the region	Soci MINIMUM VIABLE Provide an overall e monitoring. What a room for improvem	PRODUCT (MVP) valuation summary re the benefits of yo ent? Is your solution	our solution? Is there a useful and cost-
	For both conventional and autonomous system Data about the region Social acceptance	Soci MINIMUM VIABLE Provide an overall e monitoring. What a room for improvem	PRODUCT (MVP) valuation summary re the benefits of yo ent? Is your solution	our solution? Is there a useful and cost-
	For both conventional and autonomous system Data about the region Social acceptance	Soci MINIMUM VIABLE Provide an overall e monitoring. What a room for improvem	PRODUCT (MVP) valuation summary re the benefits of yo ent? Is your solution	our solution? Is there a useful and cost-
	For both conventional and autonomous system Data about the region Social acceptance MVP 1 MVP 2 MVP 3	Soci MINIMUM VIABLE Provide an overall e monitoring. What a room for improvem	PRODUCT (MVP) valuation summary re the benefits of yo ent? Is your solution photos of your MVP.	our solution? Is there a useful and cost-
	For both conventional and autonomous system Data about the region Social acceptance MVP 1 MVP 2 MVP 3	Soci MINIMUM VIABLE Provide an overall e monitoring. What a room for improvem beneficial? Include p MARY ASSESSMENT F	PRODUCT (MVP) valuation summary re the benefits of yo ent? Is your solution photos of your MVP. ROM THE FOCUS GR	our solution? Is there a useful and cost-
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# 2.4 Evaluation timeplan

As mentioned previously in this document, the evaluation of the large-scale pilots will be implemented using online meetings and evaluation report templates.

### 2.4.1 Online meetings

Regarding the online meetings, these will take place each month, initiating interaction in January 2022. One monthly meeting will be organised with all LSP leaders in order to:

- a. Give updates on the execution of the timeline;
- b. Inform about the developments of the LSPs;
- c. Inform about possible deviations from the expected timeline and activities;
- d. Indicate possible problems encountered during pilot activities and try to find solutions;
- e. Make sure that the evaluation protocol is followed throughout the implementation of the LSPs and follow-up on the KPIs that have to be measured during all the stages of pilot implementation.
- f. Briefly report on the assessments of the LSP Focus Groups on pilot activities.

#### 2.4.2 Reporting via individual evaluation templates

The official evaluation of the LSPs and their minimum viable products will be implemented using the evaluation templates presented in this deliverable (section 2.3). Although the activities, measurements, timeline and alignment with the KPIs of the LSPs will be monitored on a monthly basis (online meetings), three official reporting periods will take place, one during the end of each experimental year, from August to October (2022, 2023, 2024). These reports will summarise all the activities, KPIs and outcomes of the LSPs, validating the three minimum viable products for each pilot. The outcomes from this reporting will support the work of Task 6.3, "Deployment, feedback collection and performance assessment in real environment", and provide input for deliverable D6.3, "Report on evaluating the performance of the robotic systems in real-environmental conditions", delivered in M24,36,48.

### 3 Large-Scale Pilot Focus Groups

In the context of WP6, Focus Groups (FGs) for each large-scale are being introduced. FGs consist of technical people, agronomy experts and field technicians. They will contribute in the work of LSPs by continuously evaluate the performance, usefulness, and benefits of the implemented solutions, as compared to their routine operations and decision making. Meetings of LSP leaders and FG members will take place on a regular basis, and feedback from FGs' assessments will be reported in the frame of WP6 (monthly meeting and annual reporting)<sup>2</sup>. In the table below, the FG members for each LSP are presented.

#### Table 5 LSP Focus Groups

Large-Scale Pilot	Focus Group members
LSP 1 - France – Vineyard and vegetable mechanical weeding with CEOL Robot	<ul> <li>Famers: at least 4, one of them is from the French institute of wine (IFV), 3 others are producers.</li> <li>Crop advisors: at least 3, from Loire-Vini- Viti-Distribution (LVVD).</li> <li>field technicians, 1 from AgreenCulture, 2 from Terrena, 1 from LVVD.</li> <li>2 agronomists, 1 from Terrena, 1 from LVVD.</li> </ul>
LSP 2 - Greece – CEOL and retrofitted tractor for spraying operations on table grapes	<ul> <li>Mark Legas, President</li> <li>Spiros Karachalios, Agronomist - Grower consultant</li> <li>Theodore Kokiousis, Project Manager</li> </ul>
LSP 3 - Spain - Apple orchards spraying with retrofitted tractor	• Field expert: Raül Sánchez • Agronomist: Oriol Serra • Technician: Josep Vidal
LSP 4 - The Netherlands - Mechanical weeding with Robotti	<ul> <li>Bram Veldhuisen (Technical expert)</li> <li>Menko Oosterhuis (Farm technician)</li> </ul>

<sup>&</sup>lt;sup>2</sup> See the last section of the individual evaluation templates (sections 2.3.1-2.3.4)