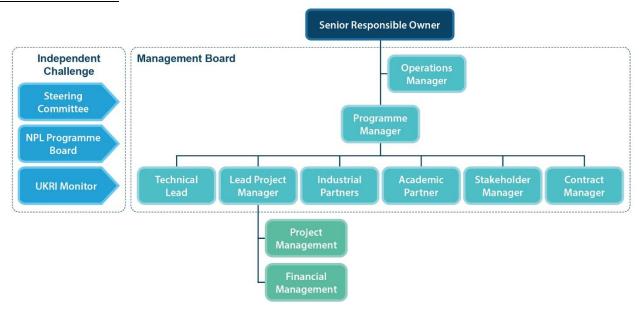
Q7 APPENDIX Project Management and Governance

1. Governance Structure



This programme will be delivered within a governance structure (shown above), which includes the following boards and committees:

- <u>Programme Board</u>: The NPL programme board will provide internal NPL oversight of the delivery of the programme and the realisation of benefits. The Board will support the Programme Manager who is accountable for the successful delivery of the programme. It will provide an escalation route for programme and project risks and issues in advance of the Management Board where programme decisions would be taken.
- Steering Committee: The Steering Committee will provide assurance that the work meets and remains aligned with regional, governmental, industry, academia needs and priorities, specifically requirements associated with innovation-led relative regional growth. It will provide external advice, direction and challenge to the programme on its level of ambition, scope, scale, operation, success factors. The committee members will also champion and raise awareness of the work amongst their stakeholder community. It will also provide advice on mitigating and addressing critical risks and issues impacting on the programme; review expected benefits and their achievement; and encourage the realisation of further benefits. The Committee Chair will be an independent person with a demonstrated track record of successful management of complex programmes. Committee Members will include senior representatives from key stakeholders, including trade associations, industry, academia, the High Value Manufacturing Catapult, local and national government agencies, including GMCA, WYCA and UKRI.
- Management Board: A Management Board will be set up with defined accountability, terms of reference, scopes and members. The purpose of the Management Board is to ensure the programme objectives are delivered according to a detailed delivery plan. The Board will exist to support the Programme Manager who chairs the group and has ultimate accountability for the successful delivery of the programme. It will contain members from each partner organisation with responsibility for delivering specific aspects of the programme, who will each provide resources and commitment to support the delivery of the programme. These partners are listed in the table below:

Acronym	Organisation	Acronym	Organisation
AMP	Advanced Machinery & Productivity Institute	UoH	University of Huddersfield
CRS	Compurent Ltd (trading as C R Solutions)	UoL	University of Leeds
FLL	Fives Landis Ltd	UoM	University of Manchester
NPL	NPL Management Ltd	UoS	University of Salford
PTG	Precision Technologies Group Ltd	WAL	Wayland Additive Ltd
RDA	Rochdale Development Agency		

2. Project Plan

The programme of work is organised according to the work breakdown structure (WBS) illustrated below.

AMPI Programme

WP 1.1

WP1 Industry led research portfolio: Five flagship projects to deliver next-generation machinery capability, each led by an industrial partner. Programme agility and inclusivity of further businesses is assured by flexible funding in WP1.6

WP2 Industry defined academic research portfolio: Nine initial workstreams, each led by an academic partner, with an industrial champion. Discovery- and demand-led agility is assured by flexible funding in WP2.10

WP3 Innovation for Machinery (I4M): A new industry support scheme to broaden impact to enable short term (<20 days) interactions to solve short-term challenges and facilitate adoption of new innovation

WP4 Industry engagement: By focussed regional engagement with industry, partners will build a critical mass of supply-chain for machinery producers and of end-users who are the supply chain of the UK's manufacturing base.

WP5 Programme & financial management: Management, adopting NPL's Project Delivery Framework

Development of a new concept Friction Stir Welding (FSW) machine

The following table shows the main work packages (WP), the lead partner and indication of involved partners, high-level milestones/deliverables (D) and gates (G), whose timings are shown in the Gantt chart. Partner involvement indicates the strong connections between academic and industrial partners across all WPs.

Work packages in this integrated programme have high levels of interdependency, shown in this high level WBS, as "work package linkages".

Lead: PTG

WP 1.1	Deve								Svv) mac	iiiie		I		.eau. PTG
Start month	3	Dura	ation (mor	nths)	24	WP L	inkages 2.	4, 2.3, 2.1,	2.8, 2.9		1		Cost	£ 898,639
Partners			AMP	CRS		FLL	NPL	PTG	RDA	UoH	UoL	UoM	UoS	WAL
Aim: To deve	•					•		• .	•	•				
and trays. Ob		_	-		_	_		•		•			•	
clamping and	_							-		-	-	deformati	on. (iii) N	Manufacture
of fully opera	tional	proto	type mach	ine wit	h test	facilit	ies, sensor	s & interfa	ces. (iv) Ru	un extensiv	ve trials.			
Gates	G1.1.	1 Resu	Ilts from D	1.1.2 to	o go t	o build	l stage (M	14); G1.1.2	Results fr	om D1.1.4	to go to b	eta releas	e (M26)	
Deliverables	D1.1.	1 Digit	al twin to	simulat	te pro	cess re	equiremen	ts and aut	omation (N	И11); D1.1	.2 Virtual	engineerii	ng analy:	sis complete
	(M14)); D1. 1	L.3 Fully c	peratio	onal p	orototy	pe machi	ne with te	st facilities	s, sensors	and inter	faces to ϵ	enable c	lient-factory
	simul	ation (M20). D1	.1.4 Re	port o	on exte	ensive pro	duction tria	als (M26).					
WP 1.2	Deve	lopm	ent of a g	rindin	g cel	l for h	igh-volur	ne produc	ction of ro	olling eler	nent bea	ring ring	s L	.ead: FLL
Start month	1	Dura	ation (mor	nths)	24	WP L	inkages 2.	4, 2.1, 2.2,	2.6, 2.8, 2	2.9			Cost	£1,409,119
Partners			AMP	CRS		FLL	NPL	PTG	RDA	UoH	UoL	UoM	UoS	WAL
Aim: To desig	n man	ufactu	re and tes	t a res	earch	platfo	rm to prov	ide a fund	amental u	nderstandi	ing of the	controllin	g param	eters for the
machine and	grindi	ng pro	cess to be	e used,	ultim	ately t	o bring to	market a	new, fully	automate	d ['] Twin Tu	ırret Grind	der' cell	for the high
volume prodi	uction	of rol	ling eleme	ent bea	aring i	rings. 7	This will b	e essential	for electr	ification o	f automot	ive vehicl	es, food	l production
machinery an	d Gre	en Ene	ergy. <i>Obj</i> :	(i) para	amete	risatio	n to enab	le adaptive	control o	f process	parameter	s in real t	ime (ii)	new inverse
kinematics (i	ii) pro	totype	e build (iv) pre/p	oost g	grind r	netrology	technique	s compati	ble with r	eal time	adaptive	control	(v) Artificia
intelligence fo	or auto	onomy	and to m	inimise	cycle	times								
Gates	G1.2.	1 Desi	gn shown	to mee	t spe	cificatio	on before	build comr	nences (M	6); G1.2.2	Chosen A	I shown to	be robi	ust (M18)
Deliverables	D1.2.	1 Mac	hine desig	n (M6);	; D1.2	. 2 mad	chine inver	se kinema	tics (M7); [D1.2.3 Mad	chine build	l (M18); D	1.2.4 Al	for adaptive
	contr	ol of th	ne bearing	grindir	ng pro	cess (N	И18); D1.2	.5 Custom	part progr	am editor(M18); D1.	2.6 Repor	t on mad	chining trials
	(M24))												
WP 1.3	Deve	lopm	ent of an	integr	rated	free-	form AM	machine	for produ	iction of r	naxillofa	cial impla	ants L	.ead: WAL
Start month	1	Dura	ation (mor	nths)	24	WP L	inkages 2.	1, 2.3, 2.4,	2.5, 2.8, 2	2.9			Cost	£2,000,000
Partners			AMP	CRS	;	FLL	NPL	PTG	RDA	UoH	UoL	UoM	UoS	WAL
Aim: Develop	the '	full er	nd to end	machi	inery	requir	ed for rap	oid manuf	acture (red	duce from	6 month	s to 2 da	ays) of p	personalised
maxillofacial i	mplan	nts wit	h accurate	, comp	lex, ir	ntricate	e shape an	d form. <i>Ob</i>	<i>j</i> : (i) E-bea	m AM mad	:hine (ii) N	ew de-po	wdering	and powder
recycling syst	ems (i	ii) met	rology hai	dware	, proc	essing	and feedb	ack algorit	hms produ	uced are ke	ey to the n	iew mach	nery.	
Gates	G1.3.	1-G1.3	3.12 Each o	delivera	able h	as a ga	ite betwee	n the desi	gn, virtual	engineerir	ng and pro	totyping s	tages.	
Deliverables	D1.3.	1 Elect	tron beam	AM m	nachin	ne (M6); D1.3.2 F	owder ha	ndling, loa	ding & rep	rocessing	equipme	nt (M6);	D1.3.3 Par
	remo	val eq	uipment (M9); D	1.3.4	De-po	owdering i	machine (I	И14); D1. 3	3.5 Geome	trical For	m & surfa	ace finis	h metrology
	equip	ment	(M21); D1	.3.6 Ele	ectro (Chemi	cal Machin	ing & Free	-Form Abr	asive Proc	essing and	Polishing	Equipm	ent (M24).
WP 1.4	Deve	lopm	ent of a h	igh-sp	eed	delive	ry feed s	ystem for	low mass	s objects	in autom	ation	L	.ead: CRS
Start month	4	Dura	ation (mor	nths)	24	WP L	inkages 2.	3, 2.3, 2.6,	2.7, 2.9				Cost	£509,414
Partners		•	AMP	CRS	;	FLL	NPL	PTG	RDA	UoH	UoL	UoM	UoS	WAL
Aim: Produce	a pro	totype	servo ba	l-conve	eying	machii	ne to enak	le high sp	eed (~220r	o/min) low	mass (<0.	.05kg), lar	ge surfa	ce area part
feeding. The	•				, -						•	• • • • • • • • • • • • • • • • • • • •	_	•
					-		· · ·					•		_

		nd beverage, a									, electrica	al & control
	1	L Results from [01 4 2 (M	23)
		L Design & virtu										
WP 1.5		Source CNC (ing ununy.	313 (1413), L	51.4.2 COI	inponent by	chen test (14121), D1.	4.3 1 1010		ead: FLL
Start month	1	Duration (mo		M/D Liv	akagas 2 '	2 2 4 2 5	26 27 2	9 2 0			Cost	
	1	AMP	nths) 24	FLL	NPL	2, 2.4, 2.3, PTG	2.6, 2.7, 2 RDA	.o, 2.9 UoH	UoL	UoM	UoS	£212,343 WAL
Partners	lon an	Open Source co				_						
	-	•	•						-			
HVM Catapul	ts and	he CNC for any Academic Instit	tutions the a	bility to	design an	d impleme	ent softwar	e in high l	evel codin	g languag	ges in the	core of the
		cient implemen		-			_			_		-
		oller and intend						tegrate to	testbed (iv) test ti	nrough in	dependent
		open licence fr								1 (2 2 4 2)		
	_	L Results from [
		L Specification		-)1.5.3 Exa	ample code
		MI (M16); D1.5		rated im	plementat	tion by a ti	nird-party	consortiur	n member	(M24).		1
WP 1.6		ole Industry-le										ead: NPL
Start month	6	Duration (mo					h project. I	nformed l	·	WP4	1	£6,000,000
Partners		AMP	CRS	FLL	NPL	PTG	RDA	UoH	UoL	UoM	UoS	WAL
		ility to respond		_			-			_		_
_		icture, addition					-				-	
		called in years 1							ub-WPs w	ill be crea	ted for ea	ach project,
	1	neet the norma										
	1	L Proposals revi					-					
	D1.6. 3 (M23)	L Call scope de	fined and ag	reed(M8	B), D1.6.2	Round 1	orojects la	unched (N	111), D1. 6	.3 Round	2 project	s launched
WP 2.1	Dvna	mic resilient r	nachines a	nd fabri	cation te	chnologi	es				Le	ead: UoL
Start month	3	Duration (mo					2.4, 2.5, 2	.6. 2.7. 2.8	}			£2,242,932
Partners		AMP	CRS	FLL	NPL	PTG		UoH	UoL	UoM	UoS	WAL
-	n high	l .	0.10			I FIG	I KDA	і ООП	UUL	OUIVI	1 003	VVAL
Lla a aut 18/a			odular, recor		e, low cos	st, Intellige		f-adapting	machine t	echnolog	gies beyor	nd state-of-
Obj (i) Develoreconfigurabl	vill inve opmen e base h spee	estigate the cor t of a lightwei d on the task d lightweight m	mbination of ght modular request; (ii) nachines (iv)	soft, lig low cos Reconfig Smart r	e, low cos htweight st robotic gurable de obotic ma	st, Intellige materials, manipula exterous e achines for	ent and self muscular tor, using and effector additive m	f-adapting actuation, a combina ors for unl	machine to sensing skation of ac known obj	echnolog kins, fabri ctuation	gies beyor cation te units, tha	nd state-of- chnologies. t is rapidly
Obj (i) Develoreconfigurabl control of hig Gates	vill inverpended by the post of the post o	estigate the cor t of a lightweig d on the task d lightweight m L Results from [mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20)	soft, lig low cos Reconfig Smart r	e, low cos htweight st robotic gurable de obotic ma Results fr	st, Intellige materials, manipula exterous e achines for om D2.1.3	ent and self muscular tor, using and effector additive notes (M38)	f-adapting actuation, a combina ors for unl nanufactu	machine to sensing skettion of action of action objecting	echnolog kins, fabri ctuation (ect and t	gies beyor cation te units, tha asks (iii)	nd state-of- chnologies. t is rapidly Design and
Obj (i) Develoreconfigurabl control of hig Gates Deliverables	opmen e base h spee G2.1.1	estigate the cort of a lightweight on the task of dightweight many of the control	mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20) e 3D manufa	soft, lig low cos Reconfig Smart r ; G2.1.2 cturing p	e, low cos htweight st robotic gurable de obotic ma Results fr platform c	materials, materials, manipula exterous e achines for om D2.1.3 reated, co	muscular and self muscular ator, using and effector additive madditive maddi	f-adapting actuation, a combina ors for unl nanufactual	machine to sensing skation of action objecting	technologicins, fabricituation (cect and tect and tect). D2.	gies beyor cation te units, tha asks (iii)	nd state-of- chnologies. t is rapidly Design and
Obj (i) Develoreconfigurabl control of hig Gates Deliverables	opmen e base h spee G2.1.1 D2.1.1	estigate the cort of a lightweight on the task of dightweight many of the control of the cort of the c	mbination of ght modular request; (ii) nachines (iv D2.1.1 (M20) e 3D manufa chine platfor	soft, lig low cos Reconfig Smart r g G2.1.2 cturing p m opera	e, low cos htweight st robotic gurable de obotic ma Results fr platform c	st, Intellige materials, manipula exterous e achines for om D2.1.3 reated, co ynamic en	ent and self muscular a tor, using and effector additive m (M38) mmissione vironment:	f-adapting actuation, a combina ors for unl manufactured d & demo s forces (e	machine to sensing skation of acknown objecting anstrated (I.g., during	cechnolog kins, fabri ctuation i ect and t M20). D2. re-mach	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3
Obj (i) Develoreconfigurabl control of hig Gates Deliverables	opmen e base h spee G2.1.1 D2.1.1 of mo Unive	estigate the cort of a lightweight on the task of dightweight machine and the smart machine and adaptable of the cort of the c	mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20) e 3D manufa chine platfor end effector	soft, lig low cos Reconfig Smart r g; G2.1.2 cturing p m opera demons	e, low cos htweight st robotic gurable do obotic ma Results fr platform c ating in dy trated and	st, Intellige materials, manipula exterous e achines for om D2.1.3 reated, co ynamic en d delivered	muscular and self muscular ator, using and effects additive managements (M38) mmissione (M38). Differents (M38). Differents (M38). Differents and (M38).	f-adapting actuation, a combination for unlandination dependent of the combination of the	machine to sensing skation of acknown objecting anstrated (I.g., during	cechnolog kins, fabri ctuation i ect and t M20). D2. re-mach	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3
Obj (i) Develoreconfigurabl control of hig Gates Deliverables	opmen e base h spee G2.1.1 of mo Unive manip	estigate the cort of a lightweight on the task of dightweight mandless and the task of task of the task of tas	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfor end effector e combination	F soft, light cost configuration in the cost cost cost cost cost cost cost cost	e, low cos htweight st robotic gurable do obotic ma Results fr platform c ating in dy trated and	st, Intellige materials, manipula exterous e achines for om D2.1.3 reated, co ynamic en d delivered	muscular and self muscular ator, using and effects additive managements (M38) mmissione (M38). Differents (M38). Differents (M38). Differents and (M38).	f-adapting actuation, a combination for unlandination dependent of the combination of the	machine to sensing skation of acknown objecting anstrated (I.g., during	cechnolog kins, fabri ctuation i ect and t M20). D2. re-mach	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M figurable	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight
Obj (i) Develoreconfigurabl control of hig Gates Deliverables WP 2.2	vill inverse properties of the spee of the	estigate the cort of a lightweight on the task of dightweight machine the smart machine in the cort of	mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20) e 3D manufachine platfor end effector e combination strengens	Reconfig Smart r G2.1.2 cturing r m opera demons on of the ystems	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri	st, Intellige materials, manipula exterous e achines for rom D2.1.3 reated, co ynamic en d delivered ve system	ent and self muscular a tor, using and effector additive m a (M38) mmissione vironments d (M38). Das s units (M5	f-adapting actuation, a combination for unlandination dependent of the combination of the	machine to sensing skation of acknown objecting anstrated (I.g., during	rechnologicins, fabrictuation of reconsisters of the construction	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M figurable	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight
Obj (i) Develoreconfigurable control of hig Gates Deliverables WP 2.2 Start month	opmen e base h spee G2.1.1 of mo Unive manip	estigate the cort of a lightweight on the task of dightweight machine in the cort of the c	mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20) e 3D manufachine platfor end effector e combination teraction sonths) 53	Reconfig Smart r G G2.1.2 cturing p m opera demons on of the ystems WP Lir	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri	materials, manipula exterous e achines for m D2.1.3 reated, co ynamic en d delivered ve system.	ent and self muscular a tor, using and effector additive m a (M38) mmissione vironments d (M38). Das s units (M5	f-adapting actuation, a combination for unlandinatured & demoss forces (62.1.4 Dem	machine to sensing skation of acknown objecting anstrated (I.g., during	wins, fabrictuation (ect and toward). D2. re-mach of reconsistence of the construction	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M figurable	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403
Obj (i) Develoreconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners	vill inverse vill	estigate the cort of a lightweight on the task of dightweight of the lightweight of the l	mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20) e 3D manufathine platfor end effector e combination teraction surths) 53	For soft, light construction is soft, light construction in the soft construction is soft construction. The soft construction is soft construction in the soft construction in the soft construction is soft construction. The soft construction is soft construction in the soft construction in the soft construction is soft construction. The soft construction is soft construction in the soft construction in the soft construction is soft construction.	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri nkages 1.!	st, Intellige materials, manipula exterous e achines for om D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG	muscular and self muscular ator, using and effector additive market (M38) mmissione vironment (M38). Dissunits (M58). According to the control of the contro	f-adapting actuation, a combination for unlandination dependent of the combination of the	machine to sensing skation of accommodal commodal commoda	M20). D2. re-mach of recon	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M figurable Cost UoS	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL
Obj (i) Develoreconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel	vill inverse base open for the	estigate the cort of a lightweight on the task of lightweight of the l	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfor end effector e combination (ateraction somethin) 53 CRS e for HRI tha	Reconfig Smart r G2.1.2 cturing p m opera demons on of the ystems WP Lin FLL t implem	e, low cos htweight st robotic gurable de obotic ma Results fr blatform c ating in dy trated and multi-dri nkages 1.4	materials, manipula exterous e achines for rom D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG Coordination	ent and self muscular attor, using end effector additive massione (M38) mmissione vironments d (M38). D2 s units (M5	f-adapting actuation, a combination for unlanding decided with the combination of the com	machine to sensing shation of act constraint of act constr	M20). D2. re-mach of recon	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess tha	nd state-of-chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL t integrates
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by develors	vill inverse base open for the	estigate the cort of a lightweight on the task of dightweight of the lightweight of the l	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfor end effector e combination teraction sombolistics at the combination of th	Reconfig Smart r Smart smart Smart smart Smart smart Smart smart Smart smart Smart smart Smart smart Smart smart Smart smart Smart smart Smart Smart smart Smart smart smart Smart smart smart Smart smart smart Smart smart smart smart Smart smart smart smart Smart smart smart smart smart smart Smart smart sma	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri nkages 1.! NPL nents the c	materials, manipula exterous e achines for rom D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordinatid	ent and self muscular attor, using end effector additive massione wironments of (M38). Dassione sunits (M5 2.6, 2.7 RDA on of action ehaviours.	f-adapting actuation, a combination of the combinat	machine to sensing shation of action objecting materials of the sensitive se	M20). D2. re-mach of recon	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess tha of three r	nd state-of-chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL t integrates main layers
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by di) learning of	vill inverse properties of the spee of the	estigate the coret of a lightweight of the task of the task of lightweight of the task of the	mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20) e 3D manufachine platforend effectore combination steraction somethins) 53 CRS e for HRI that architechierarchical	Reconfig Smart r Cturing p m opera demons on of the ystems WP Lin ture and combina	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri hkages 1.9 NPL hents the c d advanced	materials, manipula exterous e achines for mom D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordinatio d motor b asks; (iii) d	ent and self muscular atter, using and effector additive massione (M38) mmissione vironments d (M38). Das s units (M5 2.6, 2.7 RDA on of action ehaviours.	f-adapting actuation, a combination of the combinat	machine to sensing shation of action objecting anstrated (I e.g. during constration amic and for tecture will control structure structur	with the control of t	gies beyor cation te units, that asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess that of three reponsible	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL t integrates main layers for torque/
Obj (i) Develor reconfigurably control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by do (i) learning of position traje	opmen e base h spee G2.1.1 D2.1.1 of mo Univer manip Huma 3 op con lemons e eleme ctory t	estigate the cort of a lightweight on the task of dightweight machine in the cort of the c	mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20) e 3D manufachine platforend effectore combination (ateraction state) 53 CRS e for HRI that iant archited hierarchical egration to the state of the	Reconfigence of the solution o	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri hkages 1.9 NPL hents the c d advanced	materials, manipula exterous e achines for mom D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordinatio d motor b asks; (iii) d	ent and self muscular atter, using and effector additive massione (M38) mmissione vironments d (M38). Das s units (M5 2.6, 2.7 RDA on of action ehaviours.	f-adapting actuation, a combination of the combinat	machine to sensing shation of action objecting anstrated (I e.g. during constration amic and for tecture will control structure structur	with the control of t	gies beyor cation te units, that asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess that of three reponsible	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL t integrates main layers for torque/
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by d (i) learning of position traje Gates	vill inverse vill	estigate the core t of a lightweight on the task of a lightweight of the lightweight of t	mbination of ght modular request; (ii) nachines (iv) D2.1.1 (M20) e 3D manufachine platforend effectore combination (teraction somethins) 53 CRS refor HRI that ant archical egration to tl D2.2.1 (M36)	soft, lig Reconfig Smart r Smart r Sma	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri nkages 1.! NPL nents the c d advanced ations of talliant mani	materials, manipula exterous e achines for om D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordinatio d motor b asks; (iii) d ipulator (D	muscular and self muscular ator, using and effector additive managements (M38) mmissione vironments (M38). Date and action ehaviours. ecentralize (2.1.4) for the muscular and action elaviours.	f-adapting actuation, a combination of the combinat	machine to sensing skation of accommodal acc	with the control of t	cation te units, tha asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess that of three reponsible aesthetic	nd state-of-chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight E700,403 WAL tintegrates main layers for torque/teaching.
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by d (i) learning of position traje Gates	opmen e base h spee G2.1.1 D2.1.1 of mo Unive manip Huma 3 op con lemons eleme ctory t G2.2.1 D2.2.1	estigate the core to falightweight of a lightweight of the task of of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfor end effector e combination (CRS) e for HRI that iant architechierarchical egration to the description of a user-fries	soft, lig Reconfig Smart r Smart r Sma	e, low coshtweight st robotic gurable de obotic ma Results frobatform conting in dy trated and multi-driven NPL nents the colladvance etions of taliant manifestations and litimodal H	materials, manipula exterous e achines for m D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordination d motor b asks; (iii) d ipulator (D	muscular and self muscular ator, using and effector additive massione vironments of (M38). Das a units (M5) and action additive massione vironments of (M38). Das a units (M5) and action actio	f-adapting actuation, a combination of the combinat	machine to sensing shation of action of action objecting the sensitive sensi	wins, fabrictuation of ect and the ect and	cation te units, tha asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess that of three reponsible aesthetic	nd state-of-chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight E700,403 WAL tintegrates main layers for torque/teaching.
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by d (i) learning of position traje Gates	opmen e base h spee G2.1.1 of mo Unive manip Huma 3 op con lemons eleme ctory t G2.2.1 and te	estigate the core tof a lightweight of a lightweight of the task of o	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfore combination (M20) teraction so the for HRI that architechier archical egration to the 22.2.1 (M36) of a user-friese. 2.2.3 Demon	Reconfig Smart r Smart	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri hkages 1.! NPL hents the c d advanced ations of t liant mani	materials, manipula exterous e achines for rom D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordinatio d motor b asks; (iii) d ipulator (D HM robotio	ent and self muscular ator, using and effector additive massione vironments (M38). Date of action ehaviours. ecentralized (2.1.4) for the case of a linter and the case of a linter alignment at the case of a linter and the	f-adapting actuation, a combination of the combinat	machine to sensing shation of action objecting materials of the sensing shation objecting materials on the sector of the skill the skill the syorkspace	with the control arc (M56).	gies beyor cation te units, that asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess that of three reponsible aesthetic	nd state-of-chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight E700,403 WAL tintegrates main layers for torque/teaching.
Obj (i) Develor reconfigurably control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by d (i) learning of position traje Gates Deliverables WP 2.3	vill inverse vill	estigate the core to fall lightweight of a lightweight of the task of of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platforend effectore combination (ateraction state) 53 CRS e for HRI that iant architechierarchical gration to tl 22.2.1 (M36) of a user-friese. 2.2.3 Demonengineering	r soft, lig Reconfig Smart r FG2.1.2 cturing p m opera demons on of the ystems WP Lin FLL t implem ture and combina ne complements	e, low coshtweight st robotic gurable de obotic ma Results froblatform cating in dy trated and multi-driven NPL nents the oblations of taliant manifolatings for the oblatings for the oblating for th	materials, manipula exterous e achines for rom D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordinatio d motor b asks; (iii) d ipulator (D HM robotio	ent and self muscular ator, using and effector additive massione vironments (M38). Date of action ehaviours. ecentralized (2.1.4) for the case of a linter and the case of a linter alignment at the case of a linter and the	f-adapting actuation, a combination of the combinat	machine to sensing shation of action objecting materials of the sensing shation objecting materials on the sector of the skill the skill the syorkspace	with the control of t	gies beyon cation te units, that asks (iii) 1.2 A dentining) (M figurable Cost UoS ocess that of three in the ponsible aesthetic chitecture	nd state-of-chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight 2ad: UoS £700,403 WAL t integrates main layers for torque/teaching. completed 2ad: UoM
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by d (i) learning of position traje Gates Deliverables WP 2.3 Start month	opmen e base h spee G2.1.1 of mo Unive manip Huma 3 op con lemons eleme ctory t G2.2.1 and te	estigate the core to falightweight of a lightweight of the task of of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufaction e platfor e combination (iteraction somethis) 53 CRS e for HRI that iant architection to the degration to the degration to the degration of a user-friese. 2.2.3 Demonengineering on this modular and the degration of the degration	Reconfig Smart r Smart	e, low coshtweight st robotic gurable de obotic ma Results froblatform cating in dy trated and multi-driven NPL nents the oblations of taliant manifolatings for the oblatings for the oblating for th	materials, manipula exterous e achines for om D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordinatio d motor b asks; (iii) d ipulator (D HM robotio the comp	ent and self muscular ator, using and effector additive massione vironments (M38). Date of action ehaviours. ecentralized (2.1.4) for the case of a linter and the case of a linter alignment at the case of a linter and the	f-adapting actuation, a combination of the combinat	machine to sensing shation of action objecting materials of the sensing shation objecting materials on the sector of the skill the skill the syorkspace	UoM lexible prough kincurs responsible consist acture responsible control arc (M56).	gies beyor cation te units, that asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess that of three reponsible aesthetic	nd state-of-chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL tintegrates main layers for torque/teaching.
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by dillearning of position traje Gates Deliverables WP 2.3 Start month Partners	vill inverse vill	estigate the core to falightweight of a lightweight of the task of of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfor end effector e combination (Marchine) 53 CRS e for HRI that iant architechierarchical egration to the 2.2.1 (M36) of a user-friese. 2.2.3 Demonengineering this 36 CRS	Reconfiger Smart response to the complex of the com	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri nkages 1.! NPL nents the c d advance ations of t liant mani ultimodal H directly in patings fo nkages NPL	materials, manipula exterous e achines for m D2.1.3 reated, co ynamic en d delivered ve system 5, 2.1, 2.3, PTG coordinatio d motor b asks; (iii) d ipulator (D HM robotic the comp	muscular mus	f-adapting actuation, a combination of the combinat	machine to sensing shation of accommodal acc	UoM Washing Washing	gies beyor cation te units, tha asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess that of three r sponsible aesthetic hitecture Cost UoS	nd state-of-chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL tintegrates main layers for torque/teaching. completed ead: UoM £456,132 WAL
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by di learning of position traje Gates Deliverables WP 2.3 Start month Partners Aim: This WP	vill inverse base open of the base open of the base open open open open open open open ope	estigate the core to falightweight of a lightweight of the task of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platforend effectore combination (CRS) e for HRI that iant architechierarchical egration to the 22.2.1 (M36) of a user-fried (CRS) entweight material material programme (M36) and the combination of the combination o	soft, lig Reconfig Smart r Sma	e, low coshtweight st robotic gurable de obotic ma Results frobation cating in dy trated and multi-driven hages 1.5 NPL ments the cations of taliant manifoliant manifoliant manifoliant structure of the object of	st, Intellige materials, manipula exterous excitines for mD2.1.3 reated, co ynamic end delivered ve system. 5, 2.1, 2.3, PTG coordinated motor basks; (iii) dipulator (DHM robotic the compor sustain PTG res, especi	muscular and self muscular ator, using and effector additive massione vironments at (M38). Date and all and manipulation and self and ally for high muscular and self and manipulation and self and manipulation and self and manipulation and self and manipulation and self and	f-adapting actuation, a combination of the combinat	machine to sensing shation of action of action objecting and the sensing shation objecting and the sensition of the sensition of the sensition of the skill the skill the skill the sensition of the sensition of the skill the sensition of the skill the skill the sensition of the skill the skill the skill the sensition of the skill the skill the skill the sensition of the skill the skill the sensition of the skill t	with the control and the contr	cation te units, that asks (iii) 1.2 A den ining) (M figurable Cost UoS ocess that of three reponsible aesthetic hitecture Cost UoS reduction	nd state-of-chnologies. t is rapidly Design and monstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL tintegrates main layers for torque/teaching. completed ead: UoM £456,132 WAL in inertial
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by dillearning of position traje Gates Deliverables WP 2.3 Start month Partners Aim: This WP forces & redu	vill inverse base open of the part of the	estigate the core t of a lightweight of on the task of lightweight of the task	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfore combination (March 1997) 53 CRS e for HRI that architechierarchical egration to the 22.2.1 (M36) of a user-frie (March 1997) 2.2.3 Demonenths) 36 CRS entweight maind; (ii) Imprince (March 1997) 36 CRS entweight maind; (iii) Imprince (March 1997) 36 CRS entweight maind; (iiii) Imprince (March 1997) 36 CRS entweight maind; (iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	soft, lig Reconfig Smart r Sma	e, low cos htweight st robotic gurable de obotic ma Results fr olatform c eting in dy trated and multi-dri nkages 1.! NPL nents the c advanced ations of t liant mani ultimodal H directly in oatings fo nkages NPL nd structu uchinery lo	st, Intellige materials, manipula exterous enchines for mD2.1.3 reated, confidence of delivered ve system. 5, 2.1, 2.3, PTG coordination of delivered to motor basks; (iii) dipulator (DIAM robotion the compor sustain PTG res, especiongevity the materials.	muscular and self muscular ator, using and effector additive massione vironments at (M38). Date of action ehaviours. ecentralized (2.1.4) for the self ally for high rough self and self ally for high rough self and self	f-adapting actuation, a combination of the combinat	machine to sensing shation of action of action objecting anstrated (I a.g. during constration) UoL amic and for tecture will control structure skill the skill the correspace dvanced UoL machinery rodened su	with the control and the contr	gies beyore cation te units, that asks (iii) 1.2 A dentining) (M figurable Cost UoS ocess that of three reponsible aesthetic hitecture Cost UoS reduction i) Tool life	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL t integrates main layers for torque/ teaching. completed ead: UoM £456,132 WAL as in inertial e extension
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by describe (i) learning of position traje Gates Deliverables WP 2.3 Start month Partners Aim: This WP forces & reduand reduced	vill inverse property of the passes of the p	estigate the core to fall lightweight of a lightweight of the task of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platforend effectore combination (iteraction state archical egration to the description of a user-fried (2.2.3 Demonengineering (ii) Imprintument (iii) Imprintument (iiii) Imprintument (iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	soft, lig Reconfig Smart r FG2.1.2 Cturing p Commons C	e, low cos htweight st robotic gurable de obotic ma Results fr clatform c ating in dy trated and multi-dri NPL nents the c diadvanced ations of t liant mani litimodal F directly in coatings fo hkages NPL nd structu achinery log eramic coa	st, Intelliged materials, manipula exterous exterous exterior model. 1.3 reated, cook manic end delivered ve system. 5, 2.1, 2.3, PTG coordination of motor by asks; (iii) dispulator (Dispulator (Dispulator (Dispulator system) pr sustain pr s	muscular and self muscular ator, using and effects additive manifestion additive manifestion additive manifestion additive manifestion additive manifestion additive manifestion additional manifestion additi	f-adapting actuation, a combination of the combinat	machine to sensing shation of action of action objecting anstrated (I a.g. during constration) UoL amic and for tecture will control structure skill the skill the correspace dvanced UoL machinery rodened su	with the control and the contr	gies beyore cation te units, that asks (iii) 1.2 A dentining) (M figurable Cost UoS ocess that of three reponsible aesthetic hitecture Cost UoS reduction i) Tool life	nd state-of- chnologies. t is rapidly Design and nonstration 38). D2.1.3 lightweight ead: UoS £700,403 WAL t integrates main layers for torque/ teaching. completed ead: UoM £456,132 WAL as in inertial e extension
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by d (i) learning of position traje Gates Deliverables WP 2.3 Start month Partners Aim: This WP forces & reduand reduced moulds; (iv) N	vill inverse property in vill inverse property	estigate the core to falightweight of a lightweight of the task of of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfor end effector e combination (iteraction someths) 53 CRS e for HRI that iant architechierarchical egration to the district of a user-frieries. 2.2.3 Demonengineering this 36 CRS entweight maind; (ii) Imprinrough advants for advants	soft, lig Reconfig Smart r FG2.1.2 Cturing p m opera demons on of the ystems WP Lin FLL t implem ture and combina ne comple endly Mu stration of g and co WP Lin FLL terials ar oved ma anced ce ced fixtu	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri NPL nents the c di advanced ations of t liant mani ultimodal H directly in catings fc nkages NPL nd structu achinery loc aramic coa res and ro	st, Intellige materials, manipula exterous eachines for rom D2.1.3 reated, co ynamic end delivered ve system. 5, 2.1, 2.3, PTG coordination of the comports with a comports with a comport sustain property that ings for obotic grip	ent and self muscular ator, using and effects additive managements (M38) mmissione vironments (M38). Do a units (M5) a uni	f-adapting actuation, a combination of the combinat	machine to sensing shation of acknown objecting anstrated (If any onstration on on one of the skill the opposite of the opposi	UoM lexible prough kin cough kin cou	gies beyon cation te units, that asks (iii) 1.2 A dentining) (M figurable Cost UoS ocess that of three reponsible aesthetic chitecture cry Le Cost UoS reduction i) Tool life or formin	nd state-of-chnologies. t is rapidly Design and monstration 38). D2.1.3 lightweight Ead: UoS £700,403 WAL tintegrates main layers for torque/teaching. completed Ead: UoM £456,132 WAL is in inertial extension in g dies and
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by d (i) learning of position traje Gates Deliverables WP 2.3 Start month Partners Aim: This WP forces & reduand reduced moulds; (iv) N Gates	vill inverse per per per per per per per per per pe	estigate the core to falightweight of a lightweight of the task of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platfor end effector e combination (mathematical effectors) 53 CRS e for HRI that iant architechierarchical effector to the desirence of a user-friese. 2.2.3 Demonence of a user-friese. CRS effect of a user-friese effector of a user-friese. CRS effector of a user-friese effector of a user-friese. CRS effector of a user-friese effector of a user-frie	soft, lig Reconfig Smart r FG2.1.2 Cturing p m opera demons on of the ystems WP Lin FLL t implem ture and combina ne compl endly Mu stration of g and co WP Lin FLL terials ar oved ma anced ce ced fixtue ntweight	e, low cos htweight st robotic gurable de obotic ma Results fr platform c ating in dy trated and multi-dri nkages 1.! NPL nents the c d advance ations of t liant mani ultimodal H directly in catings fo nkages NPL nd structu uchinery lo eramic coa res and ro ing (M8),	st, Intelliged materials, manipula exterous exterous exterior modelines for modelines for modelines for modelines for system. 5, 2.1, 2.3, PTG coordinated motor basks; (iii) dispulator (Dispulator (Dispulator system) pr sustain pr sustain pr sustain pr sustain proportion for modelines for system pr sustain	muscular muscular muscular ator, using and effector additive muscular additive muscu	f-adapting actuation, a combination of the combinat	machine to sensing shation of accommodal acc	UoM lexible prough kin control arc (M56). machine rfaces; (ii oatings fardening fardening	gies beyon cation te units, that asks (iii) 1.2 A dentining) (M figurable Cost UoS occess that of three reponsible aesthetic chitecture Ery Le Cost UoS reduction i) Tool life or formin (M12), G2	nd state-of-chnologies. t is rapidly Design and monstration 38). D2.1.3 lightweight Ead: UoS £700,403 WAL tintegrates main layers for torque/teaching. completed Ead: UoM £456,132 WAL is in inertial extension in g dies and
Obj (i) Develor reconfigurable control of hig Gates Deliverables WP 2.2 Start month Partners Aim: To devel teaching by di learning of position traje Gates Deliverables WP 2.3 Start month Partners Aim: This WP forces & reduand reduced moulds; (iv) N Gates	vill inverse per per per per per per per per per pe	estigate the core to falightweight of a lightweight of the task of of	mbination of ght modular request; (ii) nachines (iv) 22.1.1 (M20) e 3D manufachine platforend effectore combination (material effectors) at the combination of the co	r soft, lig Reconfig Smart r r r G2.1.2 cturing r m opera demons on of the ystems WP Lin ture and combina ne comple endly Mu stration g and co WP Lin FLL terials ar oved ma anced ce ced fixtue ntweight (M12), G	e, low coshtweight st robotic gurable de obotic ma Results frobation cating in dy trated and multi-driven hages 1.5 NPL ments the cations of taliant manifestations of taliant	st, Intelliged materials, manipula exterous exterous exteriors for mD2.1.3 reated, coordination of the comport sustain pTG res, especingevity thatings for obotic grip G2.3.2 define comports.	muscular and self muscular ator, using and effector additive massione vironments at (M38). Date of a composition of action ehaviours. ecentralized (2.1.4) for the composition of action able, producting to opers. Since composition of action and ally for high arough selecting to opers.	f-adapting actuation, a combination of the combinat	machine to sensing shation of action of action of action objecting and the sensing on strated (I and a sensing on strated). UoL amic and for the skill the skill the skill the skill the skill the strategy of the sensing of the sens	with the control and the contr	cation te units, that asks (iii) 1.2 A denining) (M figurable Cost UoS ocess that of three reponsible aesthetic hitecture Cost UoS reduction i) Tool life or formin (M12), G2 (M12).	nd state-of-chnologies. t is rapidly Design and choostration 38). D2.1.3 lightweight ead: UoS £700,403 WAL tintegrates main layers for torque/teaching. completed ead: UoM £456,132 WAL as in inertial extension ag dies and 2.3.3 define

Start month		a optiiiis	ation thre	ough vir	tual tools						Le	ead: UoH
		ation (mo			inkages 1.1		1.4, 1.5, 2	2.1, 2.3, 2.6	5, 2.7, 2.8			£1,300,000
Partners		AMP	CRS	FLL	NPL	PTG	RDA	UoH	UoL	UoM	UoS	WAL
Aim: Create	simulation to	ools for ke	ev machine	ery and i	orocesses n	nost relev	ant to the	industria	l partners	and futu	re deman	nds. <i>Obi:</i> (i)
parameter id			•						•			
CAE tool and		-	-			-	-		_			
methods) for	partner test	ing.				•						
Gates	G2.4.1 virtu		eliminary n	nodel pe	rformance i	is design c	apable (M	136), G2.4.	2 Virtual t	ools usabi	ility feedb	ack (M54)
Deliverables	D2.4.1 Deta	ail of iden	tified macl	hinery ar	nd perform	ance para	meters (N	/112), D2.4	.2 virtual	tool mod	el definiti	ons (M30),
	D2.4.3 Prot			-	-	-	-	-				
WP 2.5	Metrology				•							ead: NPL
Start month	1 Dura	ation (mo	nths) 56	6 WP L	inkages 1.1	l, 1.3, 1.5,	2.3, 2.6, 2	2.7, 2.8, 2.9)		Cost	£1,100,000
Partners	,	AMP	CRS	FLL	NPL	PTG	RDA	UoH	UoL	UoM	UoS	WAL
Aim: To creat	e the necess	ary instru	mentation	to suppo	ort advance	d machine	s in carria	ble enviro	nments. C	bj: (i)Deve	elop a dyr	namic infra-
red, optical-		-										
environment												
verification o	f high accura	cy compo	nents and	high pre	cision manı	ufacturing	machines					
Gates	G2.5.1 Hard	dware pro	cured and	commiss	sioned - tea	am trained	d (M8), G 2	2.5.2 Hard	ware proc	ured (M8), G2.5.3	Instrument
	built and te								•			
Deliverables	D2.5.1 Prot	ocol for se	elf-calibrat	ion routi	ne of robot	using sta	tic target i	measurem	ent demo	nstrated (M26), D2	. 5.2 Target
	spec tested					_	_					_
	environmer	-								•	-	
	correction of	of multiple	e, connecte	ed robots	demonstra	ated using	dynamic ı	neasurem	ents (M56	5)	, ,	
WP 2.6	Cyber-Phy						-		,	•	Le	ead: UoH
Start month		ation (mo			inkages 1.4	-		2.5. 2.7. 2.8	3			£1,206,132
Partners	. , , , , ,	AMP	CRS	FLL	NPL	PTG	RDA	UoH	UoL	UoM	UoS	WAL
Aim: A frame	ework for m											I
between sub					-				-	-		
innovation o	-							-				
	-	-	_				-			-		-
		pennisaero				ions in w	27 X (III) 6	mhedding	, metrolog	v data tr	ansfer (iv) Real-time
	ot arives to	r criteria s										
-			such as ene	ergy use,	output qua	ality indice	s and fau	lt mitigation	n with th	e system-	level com	
data and co-	ordinating co	ntrol acro	such as ene oss multiple	ergy use, e drives (output qua v) energy e	ality indice fficient, se	s and fau If-optimis	lt mitigation	on with the drive syste	e system- ms for ma	level com achinery.	bination of
data and co-o	G2.6.1 Cybe	ntrol acro er-Physica	such as ene ess multiple I framewor	ergy use, e drives (rk applie	output qua v) energy e d to MDoF (ality indice fficient, se control\ sy	s and fau If-optimis stem (M2	lt mitigatio ing multi-o 19), G2.6.2	on with the drive syste Standard	e system- ms for ma interface	level com achinery. evaluatio	bination of n (M33)
data and co-	G2.6.1 Cybe	ontrol acro er-Physica re and su	such as ene ess multiple I framewor ebsystem t	ergy use, e drives (rk applied ype sele	output qua v) energy e d to MDoF o ection (M12	ality indice fficient, secontrol\sylvants. 1). D2.6.2	s and fau If-optimis stem (M2 C-P fram	It mitigation ing multi-on 19), G2.6.2 nework de	on with the drive syste Standard esign, with	e system- ms for ma interface n optimisa	level com achinery. evaluatio ation (M2	n (M33) 23). D2.6.3
data and co-o	G2.6.1 Cybe D2.6.1 Driv Performance	er-Physica re and su e validation	such as ene oss multiple I framewor obsystem ton against	ergy use, e drives (rk applied ype sele MDoF A	output qua v) energy e d to MDoF o ection (M11 MPI machi	ality indice fficient, se control\ sy 1). D2.6.2 nery, usin	es and fau elf-optimis vstem (M2 C-P fram g standar	It mitigation ing multi-on 19), G2.6.2 nework de	on with the drive syste Standard esign, with	e system- ms for ma interface n optimisa	level com achinery. evaluatio ation (M2	n (M33) 23). D2.6.3
data and co-o Gates Deliverables	G2.6.1 Cybe D2.6.1 Driv Performand demonstrat	entrol acro er-Physica re and su se validations or (M33).	such as ene oss multiple I framewor obsystem ton against D.2.6.5 Fa	ergy use, e drives (rk applied ype sele MDoF A ult mitig	output qua v) energy e d to MDoF o ection (M12 MPI machi ation algori	ality indice fficient, se control\ sy 1). D2.6.2 nery, usin	es and fau elf-optimis vstem (M2 C-P fram g standar	It mitigation ing multi-on 19), G2.6.2 nework de	on with the drive syste Standard esign, with	e system- ms for ma interface n optimisa	level com achinery. evaluatio ation (M2 ergy optir	23). D2.6.3 mised drive
data and co-d Gates Deliverables	G2.6.1 Cybe D2.6.1 Driv Performand demonstrat	er-Physica ye and su se validation for (M33).	such as end ess multiple I framewor absystem ton against D.2.6.5 Fa ufacturing	ergy use, e drives (rk applied ype sele MDoF A ult mitig	output qua v) energy e d to MDoF o ection (M12 MPI machi ation algori	ality indice fficient, se control\sy 1). D2.6.2 nery, usin thms (M3	es and fau elf-optimis vstem (M2 C-P fram g standar 9).	It mitigation ing multi-ce (19), G2.6.2 nework de dinterface	on with the drive syste Standard esign, with e (M29). I	e system- ims for ma interface n optimisa D2.6.4 End	level com achinery. evaluatio ation (M2 ergy optir	n (M33) 23). D2.6.3 mised drive
data and co-d Gates Deliverables WP 2.7 Start month	G2.6.1 Cybe D2.6.1 Driv Performand demonstrat	entrol acro er-Physica re and su ee validation for (M33). ous manu eation (mo	such as ene oss multiple I framewor obsystem t on against D.2.6.5 Fa offacturing onths) 56	ergy use, e drives (rk applied ype sele MDoF A ult mitig machin 6 WP L	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9	ality indice fficient, se control\sy 1). D2.6.2 nery, usin thms (M3	s and fau Ilf-optimis vstem (M2 C-P fram g standar 9).	It mitigation ing multi-ce (19), G2.6.2 nework de dinterface (1.2, 1.5, 1.2	on with the drive system Standard risign, with the (M29).	e system- ms for ma interface n optimis D2.6.4 End	level com achinery. evaluatio ation (M2 ergy optir	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000
data and co-o Gates Deliverables WP 2.7 Start month Partners	G2.6.1 Cybe D2.6.1 Driv Performance demonstrat Autonome 1 Dura	entrol acro er-Physica re and su ee validation for (M33). Dus manu ation (mon AMP	such as enemons multiple of the service of the serv	ergy use, e drives (rk applied ype sele MDoF A ult mitig machin WP L FLL	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9	ality indice fficient, se control\ sy 1). D2.6.2 nery, usin thms (M3	es and fau olf-optimis vstem (M2 C-P fram g standar 9). 2.3, 2.1, 2	It mitigation ing multi-ce (19), G2.6.2 nework de dinterface (1.2, 1.5, 1.2	on with the drive system Standard sign, with the (M29). I	e system- ms for ma interface o optimisa D2.6.4 End	level com achinery. evaluatio ation (M2 ergy optin Le Cost UoS	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL
data and co-d Gates Deliverables WP 2.7 Start month Partners Aim: To dedu	G2.6.1 Cybe D2.6.1 Driv Performance demonstrat Autonome 1 Dura	er-Physica ye and su te validation for (M33). tous manuation (mon AMP tesary data	such as enements multiple I framework absystem ton against D.2.6.5 Faufacturing nths) 56 CRS and knowl	ergy use, e drives (rk applied ype sele MDOF A ult mitig machin WP L FLL edge stre	output qua v) energy e d to MDoF of ection (M12 MPI machi ation algori es inkages 2.9 NPL eams (dema	ality indice fficient, se control\sy 1). D2.6.2 nery, usin thms (M3 0, 2.6, 2.4, PTG ands, comi	es and fau elf-optimis estem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se	It mitigation ing multi-ce (19), G2.6.2 nework de dinterface (1.2, 1.5, 1.2 UoH nsors, etc.	on with the drive systes Standard esign, with the (M29). I UoL) and algo	e system- ms for ma interface n optimisa D2.6.4 End UoM rithms to	level com achinery. evaluatio ation (M2 ergy optir Le Cost UoS allow mar	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing
data and co-o Gates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to	G2.6.1 Cybe D2.6.1 Driv Performance demonstrat Autonome 1 Dura ce the neces o operate au	entrol acro er-Physica ve and su ee validation or (M33). bus manu ation (more AMP essary data tonomous	such as energy system to against D.2.6.5 Faufacturing nths) 56 CRS and knowledges and knowledges systems of the control of the	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (output qua v) energy e d to MDoF o ection (M12 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical,	ality indice fficient, se control\sy 1). D2.6.2 nery, usin thms (M3 0, 2.6, 2.4, PTG ands, come sampling	es and fau Ilf-optimis vstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data	It mitigation ing multi-ce ing	on with the drive system Standard esign, with the (M29). I UoL) and algo definitions	e system- ms for ma interface n optimisa D2.6.4 End UoM rithms to s for embe	level com achinery. evaluatio ation (M2 ergy optin Le Cost UoS allow maredded aw	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing areness (ii)
data and co-o Gates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application o	G2.6.1 Cybe D2.6.1 Driv Performance demonstrat Autonome 1 Dura toe the necess operate au f self-learnin	entrol acro er-Physica re and su se validation or (M33). Dus manu ation (more sary data tonomous g and cog	such as enemons multiple I framework Ibsystem ton against D.2.6.5 Faufacturing nths) 56 CRS and knowled Sty by designitive tools	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L FLL edge stre gn. Obj: (s (iii) fide	output qua v) energy e d to MDoF o ection (M13 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical, lity of data	ality indice fficient, se control\sy 1). D2.6.2 nery, usin thms (M3 2, 2.6, 2.4, PTG ands, comissampling and decisi	es and fau elf-optimis estem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin	It mitigation in multi-ce (19), G2.6.2 nework ded interface (1.2, 1.5, 1.2	on with the drive system Standard esign, with the (M29). I UoL and algo definitions etric for co	e system- ms for ma interface n optimisa D2.6.4 End UoM rithms to s for embe nfidence a	level com achinery. evaluatio ation (M2 ergy optin Le Cost UoS allow mare edded aw and uncer	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing areness (ii)
data and co-o Gates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application o Gates	Performance demonstrate Autonomous 1 Durance the necessor operate auf self-learnin G2.7.1 Deci	entrol acro er-Physica re and su ee validatie for (M33). Dus manu ation (moi AMP esary data tonomous g and cog sion on ex	such as enements multiple of the service of the ser	ergy use, e drives (rk applied ype sele MDOF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical, lity of data	ality indice fficient, se control\ sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, com sampling and decisi 7.1 (M12),	es and fau elf-optimis existem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 D	It mitigation ing multi-ce (19), G2.6.2 nework de dinterface (1.2, 1.5, 1.2) UoH nsors, etc. structure of g, with me eployment	on with the drive system Standard esign, with the (M29). I UoL) and algo definitions the control of the contr	e system- interface n optimis 2.6.4 End UoM rithms to s for embe nfidence a D2.7.4 (N	level com achinery. evaluatio ation (M2 ergy optir Cost UoS allow maredded aw and uncer	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing areness (ii)
data and co-o Gates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application o	Performance demonstrate Autonomous de the necesso operate autonomous description de control de cont	entrol acro er-Physica re and su re validation cor (M33). Dus manu ation (mon AMP asary data atonomous g and cog sion on ex ort on info	such as enements multiple of the service of the ser	ergy use, e drives (rk applied ype sele MDOF A ult mitig machin b WP L edge stre gn. Obj: (s (iii) fide ce neede	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical, lity of data ed after D2. r machinery	ality indice fficient, se control\ sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, come sampling and decisi 7.1 (M12), y builders	es and fau elf-optimis vstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa	It mitigation ing multi-ce (19), G2.6.2 nework de dinterface (1.2, 1.5, 1.2) UoH nsors, etc. structure of g, with meeployment ble algorit	on with the drive system Standard resign, with the (M29). In the control of the c	UoM rithms to for ember for ember D2.7.4 (N	level com achinery. evaluatio ation (M2 ergy optin Cost UoS allow manedded aw and uncer M52) oolkit of in	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing areness (ii) rtainty
data and co-o Gates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application o Gates	G2.6.1 Cybe D2.6.1 Driv Performance demonstrat Autonome 1 Dura ce the necess operate au f self-learnin G2.7.1 Deci D2.7.1 Repo	entrol acro er-Physica re and su se validation or (M33). ous manu ation (mon AMP ssary data atonomous g and cog sion on ex ort on info cluding ou	such as energy system to against D.2.6.5 Faufacturing nths) 56 CRS and knowled by designitive tools tra resource remation states at the control of the contr	ergy use, e drives (rk applied ype sele MDOF A ult mitig machin b WP L edge stre gn. Obj: (s (iii) fide ce neede	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical, lity of data ed after D2. r machinery	ality indice fficient, se control\ sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, come sampling and decisi 7.1 (M12), y builders	es and fau elf-optimis vstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa	It mitigation ing multi-ce (19), G2.6.2 nework de dinterface (1.2, 1.5, 1.2) UoH nsors, etc. structure of g, with meeployment ble algorit	on with the drive system Standard esign, with the (M29). I UoL) and algo definitions tric for control to the control the con	UoM rithms to for ember for ember D2.7.4 (N	level com achinery. evaluatio ation (M2 ergy optin Cost UoS allow manedded aw and uncer M52) oolkit of in	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing areness (ii) rtainty
data and co-ordinates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application of Gates Deliverables	Performance demonstrate Autonomous operate auf self-learnin G2.7.1 Repostreams, in manufactur	entrol acro er-Physica re and su se validation or (M33). Dus manu ation (mon sary data tonomous g and cog sion on ex ort on info cluding out ing machi	such as enemons multiple of the series of th	ergy use, e drives (rk applier ype sele MDoF Ault mitigemachin machin for MP Ledge street gn. Obj: (s (iii) fide the meede reams for D2.9.2 (machin for the meede for the	output qua v) energy e d to MDoF of ection (M12 MPI machi ation algori les inkages 2.9 NPL eams (demai i) physical, lity of data ed after D2.7 r machinery (M23) D2.7	ality indice fficient, se control\ sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, come sampling and decisi 7.1 (M12), y builders	es and fau elf-optimis vstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa	It mitigation ing multi-ce (19), G2.6.2 nework de dinterface (1.2, 1.5, 1.2) UoH nsors, etc. structure of g, with meeployment ble algorit	on with the drive system Standard esign, with the (M29). I UoL) and algo definitions tric for control to the control the con	UoM rithms to for ember for ember D2.7.4 (N	level com achinery. evaluatio ation (M2 ergy optin Le Cost UoS allow man edded aw and uncer (152) oolkit of in	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL mufacturing areness (ii) rtainty nformation stration on
data and co-off Gates Deliverables WP 2.7 Start month Partners Aim: To dedumachinery to application off Gates Deliverables WP 2.8	Performance demonstrat Autonome 1 Dura ce the necess operate aut f self-learnin G2.7.1 Deci D2.7.1 Repostreams, in manufactur Advanced	er-Physical re and sure validation (M33). Dus manuation (more and condition of the conditi	such as enemons multiple of the series of th	ergy use, e drives (rk applied ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical, lity of data d after D2.7 machinery (M23) D2.7	ality indice fficient, secontrol\ sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, comisampling and decisi 7.1 (M12), y builders 3.3 Algoritl	es and fau elf-optimis estem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste	th mitigation ing multi-ce (19), G2.6.2 nework ded interface (1.2, 1.5, 1.2) L2, 1.5, 1.2 L3, 1.5, 1.2 L4 L5, 1.5, 1.2 L5, 1.5, 1.2 L6 L7 L9 L9 L9 L9 L9 L9 L9 L9 L9	on with the drive system Standard esign, with the (M29). I UoL) and algo definitions the control of the contr	UoM rithms to for ember p2.6.4 (N p2.7.4 (N p2.7.2 T 42) p2.7.	level com achinery. evaluatio ation (M2 ergy optin Le Cost UoS allow man edded aw and uncer M52) oolkit of in 4 Demon	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing areness (ii) tainty nformation stration on
data and co-ordates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application of Gates Deliverables WP 2.8 Start month	Performance demonstrat Autonome 1 Dura ce the necess operate aut f self-learnin G2.7.1 Deci D2.7.1 Repostreams, in manufactur Advanced	entrol acro er-Physica re and su re validation cor (M33). Dus manu ation (mon AMP assary data atonomous g and cog sion on ex ort on info cluding out ing machi error cor ation (mon	such as energy system to against D.2.6.5 Faufacturing nths) 56 CRS and knowledge by designitive tools stra resource remation structure (M50).	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (md comp	output qua v) energy e d to MDoF of ection (M12 MPI machi ation algori les inkages 2.9 NPL eams (dema- i) physical, lity of data d after D2.1 r machinery (M23) D2.7	ality indice officient, secontrol\sy. 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, come sampling and decising and decision and decisi	s and fau Ilf-optimis stem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste	It mitigation ing multi-ce ing	on with the drive system Standard esign, with the (M29). I UoL) and algo definitions tric for combased on hims (M10 luated (Market) (M28).	UoM rithms to for ember for ember fo	level com achinery. evaluatio ation (M2 ergy optin Le Cost UoS allow mare edded aw and uncer 152) oolkit of in 4 Demon Le Cost	m (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing areness (ii) tainty nformation stration on ead: UoH £571,564
data and co-ordates Deliverables WP 2.7 Start month Partners Aim: To dedumachinery to application of Gates Deliverables WP 2.8 Start month Partners	G2.6.1 Cybe D2.6.1 Driv Performance demonstrat Autonome 1 Dura Ice the necess operate au f self-learnin G2.7.1 Deci D2.7.1 Repo streams, in manufactur Advanced 4 Dura	entrol acro er-Physica re and su re validation or (M33). Dus manu ation (mon ation on ex ort on info cluding out ing machi error cor ation (mon ation (mo	such as energy such a	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L FLL	output qua v) energy e d to MDoF of ection (M12 MPI machi ation algori les inkages 2.9 NPL eams (demai i) physical, lity of data d after D2.7 machinery (M23) D2.7	ality indice officient, secontrol\syll). D2.6.2 nery, usin thms (M3 2, 2.6, 2.4, PTG ands, come sampling and decisi 7.1 (M12), y builders 1.3 Algorith 1.1.2, 1.3, PTG	s and fau Ilf-optimis rstem (M2 C-P fram g standar g). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA	It mitigation in multi-ce in m	on with the drive system Standard esign, with the (M29). If the (M29). If the (M29) and algo definitions extric for combane (M10) luated (M10) and the (M10) and	UoM rithms to for embernfidence a D2.7.4 (N D2.7.2 T 42) D2.7.	level com achinery. evaluatio ation (M2 ergy optin Le Cost UoS allow man edded aw and uncer (M52) oolkit of in 4 Demon Le Cost UoS	m (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL mufacturing areness (ii) rtainty mformation stration on ead: UoH £571,564 WAL
data and co-of Gates Deliverables WP 2.7 Start month Partners Aim: To dedumachinery to application of Gates Deliverables WP 2.8 Start month Partners Aim: This WF	Performance demonstrat Autonome 1 Dura Ice the necess operate autor self-learnin G2.7.1 Deci D2.7.1 Repostreams, in manufactur Advanced 4 Dura Will focus o	entrol acro er-Physica re and su re validation or (M33). Dus manu ation (moi AMP resary data atonomous g and cog sion on ex ort on info cluding out ing machi error cor ation (moi AMP n reducing	such as energy such as energy such as energy such as energy such as multiple on against D.2.6.5 Fautacturing on this and knowledge of the constitution of the constitu	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L FLL t spatiall	output qua v) energy e d to MDoF of ection (M12 MPI machi ation algori les inkages 2.9 NPL eams (dema i) physical, lity of data d after D2.7 machinery (M23) D2.7 pensation inkages 1.1 NPL y and temp	ality indice fficient, se control\sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, com sampling and decisi 7.1 (M12), y builders 2.3 Algoritl 1, 1.2, 1.3, PTG porally var	s and fau Ilf-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA	It mitigation in multi-ce in m	on with the drive system Standard esign, with the (M29). I UoL and algo definitions thric for containing the M10 luated (M 5, 2.8 UoL standard	uom vinterface n optimiss oz.6.4 End Uom rithms to s for embe nfidence a D2.7.4 (N) D2.7.2 T 42) D2.7.	level com achinery. evaluatio ation (M2 ergy optin Le Cost UoS allow man edded aw and uncer (152) oolkit of in 4 Demon Le Cost UoS Ifigurable	m (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL mufacturing areness (ii) tainty mformation stration on ead: UoH £571,564 WAL machinery
data and co-ordinates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application ordinates Deliverables WP 2.8 Start month Partners Aim: This WF including the	Performance demonstrat Autonome 1 Dura ce the necess operate autore self-learnin G2.7.1 Deci D2.7.1 Repostreams, in manufactur Advanced 4 Dura will focus ormal, dynam	entrol acro er-Physica re and su re validation cor (M33). Dus manuation (more AMP resary data attonomous g and cog sion on export on info cluding out ing machi error cor ation (more AMP n reducing nic, and st	such as energy such as energy such as energy such as energy such as multiple on against D.2.6.5 Faufacturing on this and knowledge of the control of the con	ergy use, e drives (rk applied ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L t spatiall stiffness.	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical, lity of data d after D2.7 machinery (M23) D2.7 pensation inkages 1.1 NPL y and temp This requir	ality indice fficient, secontrol\sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, comisampling and decisi 7.1 (M12), y builders 1, 1.2, 1.3, PTG porally var res researce	s and fau If-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA iant errors ch into thi	the mitigation in multi-ce in	on with the drive system Standard esign, with the (M29). I UoL) and algo definitions tric for combassed on homs (M10) luated (M 5, 2.8 UoL standard reas (i) ro	uoM rithms to 52.7.4 (N) D2.7.2 T 42) D2.7. UoM and recorbust erro	level come achinery. evaluation (M2 ergy optimergy optimergy) Cost UoS allow manedded awand uncer (M52) coolkit of in the cost UoS offigurable remodelling modelling achieved the cost	m (M33) 23). D2.6.3 mised drive ead: UoH
data and co-of Gates Deliverables WP 2.7 Start month Partners Aim: To dedumachinery to application of Gates Deliverables WP 2.8 Start month Partners Aim: This WF including the measurement	Performance demonstrate Autonomo demonstrate Autonomo demonstrate demonstrate autonomo demonstrate demonstrate autonomo demonstrate demonstrate demonstrate demonstrate demonstrate demonstrate demonstrate autonomo demonstrate demonstra	er-Physical re and sure validation (M33). Dus manuation (monostron on expert on infoculding outing maching maching maching maching and cogning maching machin	such as energy such as energy stem to against D.2.6.5 Faufacturing nths) 56 CRS and knowledge by designitive tools (tra resour armation statput from the (M50). Trection author of the selection action of the selection of the selectio	ergy use, e drives (rk applied ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L t spatiall stiffness.	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical, lity of data d after D2.7 machinery (M23) D2.7 pensation inkages 1.1 NPL y and temp This requir	ality indice fficient, secontrol\sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, comisampling and decisi 7.1 (M12), y builders 1, 1.2, 1.3, PTG porally var res researce	s and fau If-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA iant errors ch into thi	the mitigation in multi-ce in	on with the drive system Standard esign, with the (M29). I UoL) and algo definitions tric for combassed on homs (M10) luated (M 5, 2.8 UoL standard reas (i) ro	uoM rithms to 52.7.4 (N) D2.7.2 T 42) D2.7. UoM and recorbust erro	level come achinery. evaluation (M2 ergy optimergy optimergy) Cost UoS allow manedded awand uncer (M52) coolkit of in the cost UoS offigurable remodelling modelling achieved the cost	m (M33) 23). D2.6.3 mised drive 2ad: UoH £875,000 WAL mufacturing areness (ii) tainty mformation stration on 2ad: UoH £571,564 WAL machinery ng (ii) rapid
data and co-ordates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application of Gates Deliverables WP 2.8 Start month Partners Aim: This WF including the measurement partner mach	Performance demonstrate Autonomo demonstrate Autonomo demonstrate demonstrate Autonomo demonstrate Autonomo demonstrate demons	er-Physical re and sure validation (M33). Dus manuation (more AMP start data tonomous g and cog sion on expert on infocluding outling maching maching maching maching maching maching and start downtime of systems.	such as energy such as energy system to against D.2.6.5 Faufacturing nths) 56 CRS and knowledge by designitive tools (tra resource remation statput from ne (M50). Trection aunths) 52 CRS g significan atic finite see) and cose.	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L t spatiall stiffness.	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori es inkages 2.9 NPL eams (dema i) physical, lity of data d after D2. r machinery (M23) D2.7 censation inkages 1.1 NPL y and temp This requir ye embedd	ality indice fficient, secontrol\ sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, come sampling and decisi 7.1 (M12), y builders 1.3 Algoritl 1.1.2, 1.3, PTG porally var es researced sensing	s and fau elf-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA iant errors ch into thi g (iii) met	It mitigation ing multi-ce (19), G2.6.2 nework ded interface (1.2, 1.5, 1.2) L.2, 1.5, 1.2 L.2, 1.5, 1.2 L.3, 1.5, 1.2 L.4, 1.5 L.5, 1.2 L.5, 1.5 L.6 L.7 L.7 L.7 L.7 L.7 L.7 L.7	on with the drive system Standard resign, with the (M29). It will be (M29). It will	UoM rithms to for embe of particular described by the compensation of the compensation	level come chinery. evaluation (M2 ergy optimals) Cost UoS allow manedded awand uncer (M52) oolkit of in the cost UoS Ifigurable r modellir tion integration	n (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL nufacturing areness (ii) rtainty mformation stration on ead: UoH £571,564 WAL machinery ng (ii) rapid gration into
data and co-o Gates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application o Gates Deliverables WP 2.8 Start month Partners Aim: This WF including the measuremen partner mach Gates	Performance demonstrate Autonomous demonstrat	er-Physical re and sure validation (M33). Dus manuation (more attion on expert on info cluding outling maching maching maching attion (more attion (more attion) (more at	such as energy such as energy such as energy such as energy such as multiple on against D.2.6.5 Fautacturing on this and knowled by designitive tools of the contraction of the contraction at the contract	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (WP L t spatiall stiffness.	output qua v) energy e d to MDoF o ection (M12 MPI machi ation algori les inkages 2.9 NPL eams (dema i) physical, lity of data d after D2. r machinery (M23) D2.7 oensation inkages 1.1 NPL y and temp This requir ve embedd	ality indice fficient, se control\sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, come sampling and decisi 7.1 (M12), y builders 1.3 Algoritl 1.1.2, 1.3, PTG corally var tes researced sensing M15), G2.	s and fau Ilf-optimis Istem (M2 C-P fram g standar g). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 D and availa nms teste 1.5, 2.1, 2 RDA iant errors ch into the g (iii) met	It mitigation in multi-ce in m	on with the drive system Standard esign, with the (M29). I with the (M29). I with the (M29). I will be (M29)	uom with the state of the state	level come achinery. evaluation (M2 ergy option Cost	m (M33) 23). D2.6.3 mised drive ead: UoH £875,000 WAL mufacturing areness (ii) rtainty mformation stration on ead: UoH £571,564 WAL machinery ng (ii) rapid gration into
data and co-ordates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application of Gates Deliverables WP 2.8 Start month Partners Aim: This WF including the measurement partner mach	Performance demonstrate Autonomo demonstrate au feelf-learnin G2.7.1 Decide D2.7.1 Repostreams, in manufactur Advanced 4 Durate Will focus ormal, dynamet (minimum dinery control G2.8.1 Part D2.8.1 Reference D2.6.1 Control G2.8.1 Reference D2.6.1 Control G2.8.1 Reference D2.6.1 Control G2.8.1 Reference D2.6.1 Control G2.6.1 Control G2.	er-Physica we and su we validation cor (M33). Dus manuation (more AMP ssary data tonomous g and cog sion on export on info cluding out ing machi error cor ation (more AMP n reducing nic, and st downtime of systems ner agreed rence more	such as energy such as energy such as energy such as energy such as multiple of the property of the property such as the property such	ergy use, e drives (rk applied ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L t spatiall stiffness. t-effectiv ry errors	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori les inkages 2.9 NPL eams (dema i) physical, lity of data d after D2.7 machinery (M23) D2.7 pensation inkages 1.1 NPL y and temp This requir ve embedd identified (learror comp	ality indice fficient, secontrol\sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, commodified and decisi 7.1 (M12), y builders 1, 1.2, 1.3, PTG porally var res researced sensing M15), G2 pensation	s and fau If-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA iant errors th into thi g (iii) met 8.2 Protot (M19) D2.	the mitigation in multi-ce (19), G2.6.2 (19), G3.6.2 (19)	on with the drive system Standard esign, with the (M29). If the (M29). If the (M29) and algo definitions the control of the co	uoM rithms to for embernidence a D2.6.4 End UoM rithms to for embernidence a D2.7.4 (N D2.7.2 T 42) D2.7. UoM and recorbust error compensa	level come achinery. evaluation (M2 ergy optimals) Cost UoS allow maned awand uncer M52) oolkit of in the cost UoS offigurable of modelling the cost in the cost i	n (M33) 23). D2.6.3 mised drive ead: UoH
data and co-o Gates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application o Gates Deliverables WP 2.8 Start month Partners Aim: This WF including the measuremen partner mach Gates	Performance demonstrate Autonomous demonstrat	er-Physica we and su we validation cor (M33). Dus manuation (more AMP ssary data tonomous g and cog sion on export on info cluding out ing machi error cor ation (more AMP n reducing nic, and st downtime of systems ner agreed rence more	such as energy such as energy such as energy such as energy such as multiple of the property of the property such as the property such	ergy use, e drives (rk applied ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L t spatiall stiffness. t-effectiv ry errors	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori les inkages 2.9 NPL eams (dema i) physical, lity of data d after D2.7 machinery (M23) D2.7 pensation inkages 1.1 NPL y and temp This requir ve embedd identified (learror comp	ality indice fficient, secontrol\sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, commodified and decisi 7.1 (M12), y builders 1, 1.2, 1.3, PTG porally var res researced sensing M15), G2 pensation	s and fau If-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA iant errors th into thi g (iii) met 8.2 Protot (M19) D2.	the mitigation in multi-ce (19), G2.6.2 (19), G3.6.2 (19)	on with the drive system Standard esign, with the (M29). If the (M29). If the (M29) and algo definitions the control of the co	uoM rithms to for embernidence a D2.6.4 End UoM rithms to for embernidence a D2.7.4 (N D2.7.2 T 42) D2.7. UoM and recorbust error compensa	level come achinery. evaluation (M2 ergy optimals) Cost UoS allow maned awand uncer M52) oolkit of in the cost UoS offigurable of modelling the cost in the cost i	m (M33) 23). D2.6.3 mised drive ead: UoH
data and co-o Gates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application o Gates Deliverables WP 2.8 Start month Partners Aim: This WF including the measuremen partner mach Gates	Performance demonstrate Autonomo demonstrate au feelf-learnin G2.7.1 Decide D2.7.1 Repostreams, in manufactur Advanced 4 Durate Will focus ormal, dynamet (minimum dinery control G2.8.1 Part D2.8.1 Reference D2.6.1 Control G2.8.1 Reference D2.6.1 Control G2.8.1 Reference D2.6.1 Control G2.8.1 Reference D2.6.1 Control G2.6.1 Control G2.	entrol acro er-Physica re and su re validation cor (M33). Dus manuation (mon AMP resary data stonomous g and cog sion on ex ort on info cluding out ing machi error cor ation (mon AMP n reducing nic, and st downtime of systems. ner agreed rence mon 3.3 Embed	such as energy such as energy such as energy such as energy such as multiple of the property o	ergy use, e drives (rk applied ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L t spatiall stiffness. t-effectiv ry errors thods for nic error	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori les inkages 2.9 NPL eams (dema i) physical, lity of data d after D2.7 machinery (M23) D2.7 pensation inkages 1.1 NPL y and temp This requir ve embedd identified (learror comp detection (ality indice fficient, secontrol\ sy 1). D2.6.2 nery, usin thms (M3 2), 2.6, 2.4, PTG ands, comisampling and decisi 7.1 (M12), y builders 1.3 Algoritl 1.1.2, 1.3, PTG corally var res researced sensing M15), G2. pensation M39) D2.8	s and fau If-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA iant errors th into thi g (iii) met 8.2 Protot (M19) D2.	the mitigation in multi-ce (19), G2.6.2 (19), G3.6.2 (19)	on with the drive system Standard esign, with the (M29). If the (M29). If the (M29) and algo definitions etric for combined (M10) luated (M10) standard reas (i) rowell-time combined (ii) rowell-time combined (iii) rowell-time (i	uoM rithms to for embernidence a D2.6.4 End UoM rithms to for embernidence a D2.7.4 (N D2.7.2 T 42) D2.7. UoM and recorbust error compensa	level come chinery. evaluation (M2 ergy optimals) Cost UoS allow manedded awand uncer M52) oolkit of in the cost UoS affigurable of modelling the cost in the cos	m (M33) 23). D2.6.3 mised drive ead: UoH
data and co-of Gates Deliverables WP 2.7 Start month Partners Aim: To dedumachinery to application of Gates Deliverables WP 2.8 Start month Partners Aim: This WF including the measurement partner mach Gates Deliverables	Performance demonstrate Autonomo demonstrate Autonomo demonstrate	entrol acro er-Physica re and su re validation cor (M33). Dus manuation (mon AMP resary data stonomous g and cog sion on ex ort on info cluding out ing machi error cor ation (mon AMP n reducing nic, and st downtime of systems. ner agreed rence mon 3.3 Embed	such as energy such as energy system ton against D.2.6.5 Faufacturing nths) 56 CRS and knowledge by designitive tools (tra resource transput from the (M50). Trection author of the system of the sys	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L t spatiall stiffness. t-effectiv ry errors thods for nic error ligent m	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori les inkages 2.9 NPL eams (dema i) physical, lity of data d after D2.7 machinery (M23) D2.7 pensation inkages 1.1 NPL y and temp This requir ve embedd identified (learror comp detection (ality indice and and ality indice and and ality indice and ality indice and ality indice and and and ality and decisi and d	s and fau elf-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA iant errors ch into thi g (iii) met 8.2 Protot (M19) D2. 3.4 Machin	the mitigation in multi-ce (19), G2.6.2 (19), G3.6.2 (19)	on with the drive system Standard esign, with the (M29). If the (M29). If the (M29) and algo definitions etric for combined (M10) luated (M10) standard reas (i) rowell-time combined (ii) rowell-time combined (iii) rowell-time (i	UoM rithms to for embernfidence and D2.7.4 (N) D2.7.2 T 42) D2.7. UoM and record bust error bust error compensarystems instacts and	level come chinery. evaluation (M2 ergy optimals) Cost UoS allow manedded awand uncer M52) oolkit of in the cost UoS affigurable of modelling the cost in the cos	m (M33) 23). D2.6.3 mised drive ead: UoH
data and co-ordinates Deliverables WP 2.7 Start month Partners Aim: To dedu machinery to application of Gates Deliverables WP 2.8 Start month Partners Aim: This WF including the measurement partner mach Gates Deliverables WP 2.9	Performance demonstrate Autonomo demonstrate Autonomo demonstrate	er-Physical re and sure validation (M33). Dus manuation (more AMP sary data atonomous g and cog sion on expert on infocluding outing machine atonomous error core aton (more AMP no reducing machine, and student of systems, ner agreed rence more 3.3 Embed nonitorin	such as energy such as energy system ton against D.2.6.5 Faufacturing nths) 56 CRS and knowledge by designitive tools (tra resource transput from the (M50). Trection author of the system of the sys	ergy use, e drives (rk applier ype sele MDoF A ult mitig machin WP L edge stre gn. Obj: (s (iii) fide ce neede reams fo D2.9.2 (MP L t spatiall stiffness. t-effectiv ry errors thods for nic error ligent m	output qua v) energy e d to MDoF o ection (M11 MPI machi ation algori les inkages 2.9 NPL eams (dema i) physical, lity of data d after D2. r machinery (M23) D2.7 censation inkages 1.1 NPL y and temp This requir ye embedd identified (le error comp detection (lachining s	ality indice and and ality indice and and ality indice and ality indice and ality indice and and and ality and decisi and d	s and fau elf-optimis rstem (M2 C-P fram g standar 9). 2.3, 2.1, 2 RDA mands, se and data on-makin G2.7.2 De and availa nms teste 1.5, 2.1, 2 RDA iant errors ch into thi g (iii) met 8.2 Protot (M19) D2. 3.4 Machin	the mitigation in multi-ce (19), G2.6.2 (19), G3.6.2 (19)	on with the drive system Standard esign, with the (M29). If the (M29). If the (M29) and algo definitions etric for combined (M10) luated (M10) standard reas (i) rowell-time combined (ii) rowell-time combined (iii) rowell-time (i	UoM rithms to for embernfidence and D2.7.4 (N) D2.7.2 T 42) D2.7. UoM and record bust error bust error compensarystems instacts and	level come chinery. evaluation (M2 ergy optine Cost	n (M33) 23). D2.6.3 mised drive ead: UoH

Aim: To define IoT sensor swarms with traceability and quantified accuracy suitable for embedding in machinery for through-life monitoring. Obj: (i) establish a specification of digital requirements for integrating metrological process data and process-related metadata. (ii) Determine the specification and development of the technology required to implement IoT swarms with traceability and quantified accuracy. (iii) Design and build a prototype to applied to a suitable demonstrator within the consortium. (iv) Short-term experiments and medium-term data capture and analysis. G2.9.1 Prototype of traceable IoT sensor array conforms to specification (M26), G2.9.2 Analysis of extracted data from Gates demonstrator system (M41), G2.9.3 Review of practical implementation of IoT system at end of project (M41), G2.9.4 Review of practical implementation of IoT system at end of programme (M56). Deliverables D2.9.1 Specification of digital requirements (M8), D2.9.2 Prototype of traceable IoT sensor array (M23), D2.9.3 Specification for demonstration of prototype (applied) (M29), D2.9.4 Developed demonstrator system (applied prototype) (M38), **D2.9.5** Practical implementation of IoT system (M56). WP 2.10 Flexible research portfolio Lead: NPL Start month **Duration (months)** 50 **WP Linkages** £1,250,000 Grant AMP PTG **RDA** UoH **Partners** CRS FLL NPL UoL UoM UoS Through the governance structure, additional projects will be created to meet discovery and demand. As well as the response to the programme determined by the review process, two rounds will be called (in years 2 and 3) to refresh the portfolio with externally-driven project ideas. If appropriate, UKRI will be invited to manage the process, which will follow the agreed cost model of the programme. G2.10.1 Proposals review thresholds met for Round 1 (M10); G2.10.2 Proposals review thresholds met for Round 2 (M22) Gates Deliverables D2.10.1 Scope defined and agreed, (M8) D2.10.2 Round 1 projects launched (M11), D2.10.3 Round 2 projects launched (M23)WP 3 Innovation for Machinery (I4M) scheme Lead: NPL Start month **Duration (months)** WP Linkages WP2 & 4 & WP1.6 Cost £1,040,000 AMP NPL **Partners CRS** FLL PTG RDA UoH UoL UoM UoS NPL will launch and administer a new industry support scheme called 'Innovation for Machinery' (I4M). Under this scheme, UK manufacturing companies will be able to apply for up to 20 days of consultancy and/or short-term measurement, design and technology foresighting projects free of charge, to help accelerate the development of new advanced manufacturing products in the UK. This scheme will help bridge the gap from a technology prototype to an industry-ready, innovative new product or service. It follows the methodology, though broadens the offering, from the very successful Analysis for Innovators (A4I) and Measurement for Recovery (M4R) programmes. Gates G3.1 after soft launch assess process for effective delivery and efficiency and make any adjustment prior to full launch (M11); G3.2 assess early outcomes and evaluation impact through Business Success Interviews (M17). **Deliverables** D3.1 - D3.5 annual reports on outcomes and impact. WP 4 **Industry Engagement** Lead: UoH **Duration (months)** Start month 56 WP Linkages WP1, 2 & 3 Cost £641,665 **Partners AMP CRS** FLL NPL PTG **RDA** UoH UoL UoM WAL The UoH Business Growth and Productivity Service run two local LEP programmes around Supply Chain, Manufacturing Growth and Technology Adoption. We will work with RDA and NPL to offer a service to local industrial partners, strengthening regional supply-chains to support the new technologies/machinery being developed across the programme. This WP will manage the regular engagement between programme partners and key industrial stakeholders. This essential function will ensure that the technical research programme matches the needs of, and maximises the impact to, local & UK industry through the advanced machinery sector. We will engage with networks like CKMA, BAMA and Make UK to ensure the support from AMPI is well communicated across the industry partners. Gates **G4.1.1 – G4.1.4** Annual reviews of industry engagement activities **Deliverables D4.1.1** Revised industry engagement plan (M30) WP 5 Programme management Lead: NPL **Duration (months)** Start month WP Linkages All Cost £2,613,818 RDA FLL NPL PTG UoH UoL **Partners** AMP **CRS** NPL's management processes are ISO 9001 accredited. A robust project management procedure (QPNPL/B/004 NPL Project Delivery Framework) will ensure an appropriate level of management and oversight of all work. This programme will be supported by NPL's Project Management Office (PMO) whose role is to manage NPL's portfolios of projects funded by a range of public and private sector bodies. A dedicated lead project manager will be assigned from the PMO, who will manage delivery of this programme on a day-to-day basis. NPL will manage the programme budget and distribution of funds to its consortium partners, using its existing finance team, structures and systems. The finance team will work closely with the programme management team to prepare accurate payment schedules, monitor delivery against these schedules and ensure that all claimed costs are eligible under UKRI guidelines. **G5.1.1** Mid-term review (M28); **G5.1.2** transfer of responsibility to AMPI Ltd (M56). Gates Deliverables D5.1.1 Consortium agreement signed by all parties (M1); D5.1.2 Detailed project plans (M6) D5.1.3 Quarterly reports to

UKRI.

3. Project Schedule

			Key	' :		Act	ivity			Deli	ivera	ble			Gat	e					
			2/	224		20	022			20	023			20	2.4			20	25		202
			Q3	021 Q4	Q1	_	Q3	Q4	Q1	Q2	_	Q4	Q1	Q2	24 Q3	Q4	Q1	_	Q3	Q4	Q1
Ref No.	Activity Description	Lead	QS	Q+					reng											Q+	
MD4	Industry Lad December Destfalls	Partner																			
WP1 1.1	Industry Led Research Portfolio New concept Friction Stir Welding machine	NPL PTG																			
1.1.1	Digital twin to simulate process regs & automation	PTG				D1															
1.1.1	Virtual engineering analysis & reporting	PTG				DI	D2	G 1													
1.1.3	Build & test fully operational prototype	PTG					DZ	O.	D3												
1.1.4	Trial prototype	PTG							D3		D4	G2									
1.2	Twin Turret Grinder Cell	FLL									54	U2									
1.2.1	Design machine	FLL			D1	G1															
1.2.2	New machine inverse kinematics	FLL	1		D2																
1.2.3	Machine build	FLL			<i>D</i> 2				D3												
1.2.4	Al for adaptive control of bearing grinding	FLL							D4	G2											
1.2.5	Custom part program editor	FLL																			
1.2.6	Write report on machining trials	FLL									D6										
1.3	Print machine for maxillofacial implants	WAL	1																		
1.3.1	Develop electron beam AM machine	WAL					G1		G2		D1	G3									
1.3.2	Develop powder processing equipment	WAL	G4	G5	D2	G6			1			-									
1.3.3	Develop part removal equipment	WAL	G7		G8	D3	G9														
1.3.4	Develop de-powdering machine	WAL	G10		G11			G12													
1.3.5	Develop form & surface finish metrology equipment	WAL		٠.		G13		G14		D5	G15										
1.3.6	Develop ECM & abrasive processing/polishing Equipment	WAL	1				G16	•	G17		•	G18									
1.4	High-speed delivery feed system	CRS					0_0		01/												
1.4.1	Design & virtual engineering analysis	CRS				D1	G1														
1.4.2	Component bench test	CRS					01			D2	G2										
1.4.3	Prototype machine	CRS								02	<u> </u>	D3									
1.5	Open source CNC control	FLL										53									
1.5.1	Specification of proposed system	FLL		D1	G1																
1.5.2	Prototype system for 3 axis machining	FLL			-		D2	G2													
1.5.3	Example code and HMI;			-			72	•												_	_
		FII						D3	G3												
		FLL						D3	G3		D4										
1.5.4	Demonstrated implementation by TP consortium member	FLL			D1	D2	G1	D3	G3	D3	D4										
1.5.4 1.6	Demonstrated implementation by TP consortium member Flexible Projects	FLL			D1	D2	G1	D3	G3	D3					_						
1.5.4 1.6 WP2	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio	FLL UoH			D1	D2	G1	D3							2/D3	G2				D4	
1.5.4 1.6 WP2 2.1	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies	FLL UoH UoS			D1	D2	G1	D3		D3				D	02/D3			D2		D4	D3
1.5.4 1.6 WP2 2.1 2.2	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems	FLL UoH UoS UoS					G1		D1	G1	G2	04		D				D2		D4	D3
1.5.4 1.6 WP2 2.1 2.2 2.3	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery	UoH UoS UoS UoM				D2				G1	G2	04	D2	D	D1 D4	G1		D2	D3	D4	
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools	UoH UoS UoS UoM UoH				G 1	G1	G2-0	D1	G1 01/D2	G2		D2		D1 D4		D4	D2	D3	D4	D4
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability	UoH UoS UoS UoM UoH NPL		(G1			D1	G1 01/D2	G2			D3	D1 D4	G1 G1	D4	D2	D3	D4	
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and	FLL UoH UoS UoS UoM UoH NPL UoH				G1		G2-6	D1	G1 01/D2 [D2	G2 ! D3/D		D2		D1 D4	G1 G1		D2		D4	D4 D5
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines	FLL UoH UoS UoS UoM UoH NPL UoH UoL		(G1		G2-0	D1	G1 01/D2	G2 ! D3/D	D3		D3	D1 D4	G1 G1 D5	D4	D2	D3		D4 D5
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation	Uoh UoS UoS UoM UoH NPL UoH UoL			61/G2	G1 D1 D1		G2-0	D1	G1 D1/D2 C D2 D2	G2 ! D3/D	D3	G1	D3	D1 D4 G1	G1 G1 D5	D3			D4	D4 D5 G2 D4
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems	Uoh Uos Uos Uom Uoh NPL Uoh Uol Uoh NPL		C	D1	G1 D1 D1	D1	G2-G3 G3 G1	D1	G1 D2 D2 D2	G2 D3/D D1/D2	D3	G1	D3	D1 D4	G1 G1 D5					D4 D5
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio	Uoh UoS UoS UoM UoH NPL UoH UoL UoH NPL NPL		(D1	G1 D1 D1	D1	G2-G3 G3 G1	D1	G1 D2 D2 D2	G2 ! D3/D	D3	G1	D3	D1 D4 G1	G1 G1 D5	D3				D4 D5 G2 D4
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme	Uoh UoS UoS UoM UoH NPL UoH UoL UoH NPL NPL NPL		C	D1	G1 D1 D1	D1	G2-G3 G3 G1	D1	G1 D2 D2 D2	G2 D3/D D1/D2	D3	G1	D3	D1 D4 G1	G1 G1 D5	D3				D4 D5 G2 D4
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme	Uoh UoS UoS UoM UoH NPL UoH UoL UoH NPL NPL NPL NPL		C	D1	G1 D1 D1	D1	G2-G3 G3 G1	D1	G1 D2 D2 D2	G2 D3/D D1/D2	D3	G1	D3	D1 D4 G1	G1 G1 D5	D3				D4 D5 G2 D4
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme	Uoh Uos Uos Uom Uoh NPL Uoh Uoh NPL NPL NPL NPL NPL NPL NPL			D1	G1 D1 D1 D2	D1	G2-0 G3 G1 G1	D1	G1 D2 D2 D2	G2 D3/D D1/D2	D3	G1	D3	D1 D4 G1	G1 G1 D5	D3				D4 D5 G2 D4
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency	Uoh Uos Uos Uom Uoh NPL Uoh Uoh NPL NPL NPL NPL NPL NPL NPL NPL NPL			D1	G1 D1 D1	D1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2	G2 D3/D D1/D2	D3	G1	D3	D1 D4 G1	G1 G1 D5	D3				D4 D5 G2 D4
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme	Uoh Uos Uos Uom Uoh NPL Uoh Uoh NPL		C	D1	G1 D1 D1 D2	D1	G2-0 G3 G1 G1	D1	G1 D2 D2 D2 D3	G2 D3/D D1/D2	D3	G1	D3	D1 D4 G1	G1 G1 D5	D3				D4 D5 G2 D4
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme	FLL UoH UoS UoS UoM UoH NPL UoH VOL NPL NPL NPL NPL NPL NPL NPL N		c	D1	G1 D1 D1 D2	D1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2	G2 D3/D D1/D2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3			D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact	FLL UoH UoS UoS UoM UoH NPL UoH VOL NPL NPL NPL NPL NPL NPL NPL N		C	D1	G1 D1 D1 D2	D1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2 D3	G2 D3/D D1/D2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3			D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement	FLL UoH UoS UoS UoM UoH NPL UOH NPL NPL NPL NPL NPL NPL NPL NP		C	D1	G1 D1 D1 D2	D1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2 D3	G2 D3/D D1/D2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3			D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4 4.1	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement Develop & maintain industry engagement plan	FLL UoH UoS UoS UoM UoH NPL UoH NPL NPL NPL NPL NPL NPL NPL NP			D1	G1 D1 D1 D2	D1 G1 G1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2 D3	G2 D3/D01/D2 G1 G2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3	D4		D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4 4.1 4.2	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement Develop & maintain industry engagement plan Industry engagement activities & events	FLL UoH UoS UoS UoM UoH NPL UOH NPL NPL NPL NPL NPL NPL NPL NP		C	D1	G1 D1 D1 D2	D1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2 D3	G2 D3/D D1/D2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3			D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4 4.1 4.2 WP5	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement Develop & maintain industry engagement plan Industry engagement activities & events Programme & Financial Management	FLL UoH UoS UoS UoM UoH NPL UOH NPL NPL NPL NPL NPL NPL NPL NP	DI		D1	G1 D1 D1 D2	D1 G1 G1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2 D3	G2 D3/D01/D2 G1 G2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3	D4		D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4 4.1 4.2 WP5 5.1	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement Develop & maintain industry engagement plan Industry engagement activities & events Programme & Financial Management Establish consortium agreement	FLL UoH UoS UoS UoM UoH NPL UOH NPL NPL NPL NPL NPL NPL NPL NP	D1		D1 D1	G1 D1 D1 D2	D1 G1 G1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2 D3	G2 D3/D01/D2 G1 G2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3	D4		D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4 4.1 4.2 WP5 5.1 5.2	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement Develop & maintain industry engagement plan Industry engagement activities & events Programme & Financial Management Establish consortium agreement Develop detailed project plans	FLL UoH UoS UoS UoM UoH NPL UOH NPL NPL NPL NPL NPL NPL NPL NP	D1	c	D1	G1 D1 D1 D2	D1 G1 G1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2 D3	G2 D3/D01/D2 G1 G2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3	D4		D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4 4.1 4.2 WP5 5.1 5.2 5.3	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement Develop & maintain industry engagement plan Industry engagement activities & events Programme & Financial Management Establish consortium agreement Develop detailed project plans Set up finances and raise partners' P/Os	FLL UoH UoS UoS UoM UoH NPL UoH UoH NPL NPL NPL NPL NPL NPL NPL NP	D1	c	D1 D1	G1 D1 D1 D2	D1 G1 G1	G2-0 G3 G1 G1	D1 D1	G1 D2 D2 D2 D3	G2 D3/D01/D2 G1 G2	D3	G1	D3 D4	D1 D4 G1	G1 G1 D5	D3	3	D4		D4 D5 D5 D5
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4 4.1 4.2 WP5 5.1 5.2 5.3 5.4	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement Develop & maintain industry engagement plan Industry engagement activities & events Programme & Financial Management Establish consortium agreement Develop detailed project plans Set up finances and raise partners' P/Os Manage finances and process claims (quarterly)	FLL UoH UoS UoS UoM UoH NPL UoH UoH NPL NPL NPL NPL NPL NPL NPL NP	DI		D1 D1	G1 D1 D1 D2	D1 G1 G1	G2-0 G3 G1 G1	D1 D1	G1 D1/D2 L D2 D2 D2 D2 D2	G2 D3/D D1/D2 G1 G2 G2	D3 D2 D3	D1 G1	D3 D4 D3	D1 D4 G1	G1 G1 D5	D3	3	D4		D4 D5 D4 D5 D4 D5 D4 D5 D4 D5 D5 D5 D6
1.5.4 1.6 WP2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 2.10 WP3 3.1 3.2 3.3 3.4 3.5 3.6 WP4 4.1 4.2 WP5 5.1 5.2 5.3	Demonstrated implementation by TP consortium member Flexible Projects Industry Defined Academic Research Portfolio Dynamic resilient machines and fabrication technologies Human-machine interaction systems Materials, surface engineering & coatings for machinery Design and optimisation through virtual tools Ultra-Precision Dynamic Process Capability Cyber-Physical interoperability of machines and Autonomous manufacturing machines Advanced error correction and compensation Dynamic monitoring of intelligent machining systems Flexible Research Portfolio Innovation for Machinery (I4M) Scheme Set up scheme Soft launch of pilot scheme Assess process for effective delivery & efficiency Promote full scheme Launch and operate full scheme Assess early outcomes and evaluation impact Industry Engagement Develop & maintain industry engagement plan Industry engagement activities & events Programme & Financial Management Establish consortium agreement Develop detailed project plans Set up finances and raise partners' P/Os	FLL UoH UoS UoS UoM UoH NPL UoH UoH NPL NPL NPL NPL NPL NPL NPL NP	DI		D1 D1	G1 D1 D1 D2	D1 G1 G1	G2-0 G3 G1 G1	D1 D1	G1 D1/D2 L D2 D2 D2 D2 D2	G2 D3/D01/D2 G1 G2	D3 D2 D3	D1 G1	D3 D4 D3	D1 D4 G1	G1 G1 D5	D3	3	D4		D4 D5 D5 D5

Accompanying notes



- Due to space constraints, the deliverable and gate numbers are displayed on the Gantt (figure 2) without their task suffixes (e.g. deliverable D1.6.2 under task 1.6 is displayed as 'D2').
- Innovation for manufacturing (I4M) Scheme: gateway reviews will be undertaken at two points in the scheme's lifecycle: (1) after the soft launch of the programme (for a small select number of companies), before full launch, to assess the process for effective delivery and efficiency, and make any adjustment prior to full launch; (2) approximately 5 months after the promotion and launch of the full programme, to assess the effectiveness of the promotion and review early outcomes seen through Business Success Interviews.
- Industry Led Research Portfolio: the projects already defined (WP1.1 through 1.5) are forecast to complete by the end of 2023, but further flexible projects (WP1.6) will be defined in the early stages of the programme, which will continue through to 2026.
- Industry Led Research Portfolio: the industrial partners are accelerating development of new products to maximise their early impact. Each partner is committed to further R&I activities in the second half of the programme to embed the outcomes from WP2. Detailed plans for this will be defined at the mid-term review.
- Programme and Financial Management: the collaboration agreement will be finalised and signed by all consortium partners in the initial project start-up phase.
- Programme and Financial Management: detailed project plans will be developed for each of the constituent projects and tasks, and approved by the management board, within 6 months of project start.
- This integrated programme has multiple cross-dependencies throughout all work packages (see Project Plan) which cannot be clearly displayed on the Gantt Chart.