
CERN

Annual Progress Report for 2018

CERN/SPC/1120/Rev. – CERN/FC/6309/Rev. – CERN/3412/Rev.

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Council – 21 June 2019

2018 Highlights (I)

- LHC and accelerator complex performance
  - The record-breaking of the peak luminosity from 2017: ~2 x 10^{34} cm^{-2} s^{-1} (x2 beyond design) was equalled
  - ~ 66 fb^{-1} to ATLAS and CMS
  - Establishment and measurement of the Higgs boson couplings to the top and bottom quarks
  - Successful heavy ion run
- LHC upgrades
  - LHC Injector Upgrade, High-Luminosity LHC and Phase I upgrades of the detectors: proceeded on schedule and on budget
  - ATLAS and CMS Phase II upgrades: most TDRs approved, memoranda for understanding for their construction awaiting signature from funding agencies
- Successful non-LHC programme
  - HIE-ISOLDE commissioned despite a faulty cryo-module
  - Beam commissioning of ELENA continued throughout the year
  - High pace progression for Neutrino Platform
  - CERN-MEDICIS Collaboration formally kicked off in 2018 and the facility delivered an increasing range of isotopes

2018 Highlights (II)

- Preparation for CERN future: finalisation of contributions for the upcoming European Strategy for Particle Physics
  - Project implementation plan for CLIC
  - Conceptual Design Report of FCC
  - Report from Physics Beyond Collider study group
- Geographical enlargement
  - Lithuania joined as Associate Member State
- Miscellaneous
  - All financial contributions to the CERN Budget received in full before the end of the year
  - CERN Environmental Protection Steering board oversaw the implementation of its first recommendations, including the improved management of wastewater
  - Implementation of the Five-Yearly Review completed (internal mobility, validation of prior learning experience)
  - Progress towards the realisation of the Science Gateway
  - Operational Circular aligning CERN with best regulations and practices produced by the Data Privacy Protection Office

2018 APR: Summary

- Document structure – unchanged
  - Executive Summary describing 2018 accomplishments over full spectrum of activities
  - Summary tables with revenues, expenses and budget balance
  - Key Performance Indicators (KPI): *enhanced with trend over three last years*
  - Appendices with details (fact sheets, more detailed financial tables, EU projects, etc.)
- Comparison of 2018 objectives (as approved in June 2017) with 2018 Out-Turn
- 2018 spending profile was reviewed during the annual planning exercise; consequently
  - 2018 Revised Budget was presented as part of the Medium-Term Plan in June 2018
  - **The 2018 Budget Out-Turn is compared to these <u>revised</u> figures**

Changes with respect to the March version

- Following feedback received from various Supervisory Committees and External Auditors
  - Some wording improvements in the narrative summary and fact sheets were implemented
  - Explanation of the difference in the presentation of the activity structure between Final 2018 Budget and APR 2018 was given
- Data for accidents concerning contractors was added (this information was not yet available for the March publication) => APR doc. page 115
- 0.5 MCHF less expenses – reduction in provision (following a settlement agreement with a supplier)

Anticipated changes for future APR editions
(and possibly also for MTP, Budget, CERN financial framework)

- Incorporate feedback, recommendations and suggestions of the various Supervisory Committees and External Auditors, in particularly
  - More concise fact sheet structure (i.e. follow MTP 2019 structure, see next slide)
  - KPIs
    - focus on a FEW core KPIs at a more prominent position in the document
    - enhance their presentation with clearly defined targets
    - separate them from key reporting figures
  - Clarification and detailing the framework for budget carry-forward procedures in the CERN financial rules (see key audit matters from External Auditors report), linked to budget allocation and carry-forward of third party revenues.

Fact sheets structure MTP 2018, APR 2018

LHC programme	1	LHC machine , reliability and consolidation
LHC experiments	2	ATLAS detector
	3	CMS detector
	4	ALICE detector
	5	LHCb detector
	6a	Totem detector
	6b	LHCf detector
	6c	MoEDAL
	6d	Common items and support to LHC detectors
	7	LHC computing
Other programmes	8	Non-LHC physics (experimental programme)
	9	Theory
	10	Knowledge transfer and medical applications
	11	Scientific support (associates, computing, R&D detectors and technical support)
	12a	Experimental areas consolidation (ELENA, HIE-ISOLDE and Linac4)
	12b	SPS complex / Accelerator maintenance and consolidation / Experimental areas consolidation
	12c	Accelerator support and services
	13	East Area renovation
Infratructure, services and centralised expenses	14	General facilities and logistics (site maintenance, transport)
	15	Informatics
	16	Safety, health and environment
	17	Administration
	18	International relations
	19	Insfrastructure consolidation, buildings and renovation
	20	Centralised expenses
Projects	21	LHC injectors upgrade (LIU)
	22	HL-LHC construction
	23	LHC detectors upgrade (Phase I) and consolidation / HL-LHC detectors, including R&D (Phase II)
	24	Linear collider studies (CLIC, ILC)
	25	Linear collider detector R&D
	26	Future Circular Collider study
	27	Proton driven plasma wakefield acceleration (AWAKE)
	28	Physics Beyond Collider (PBC)
	29	CERN neutrino platform
	30	Superconducting RF studies
	31	Superconducting magnet R&D (SCM)
	32a	EU supported computing R&D (IT)
	32b	Support to FAIR, ITER, ESS (with corresponding revenues)

Fact sheets structure MTP 2019

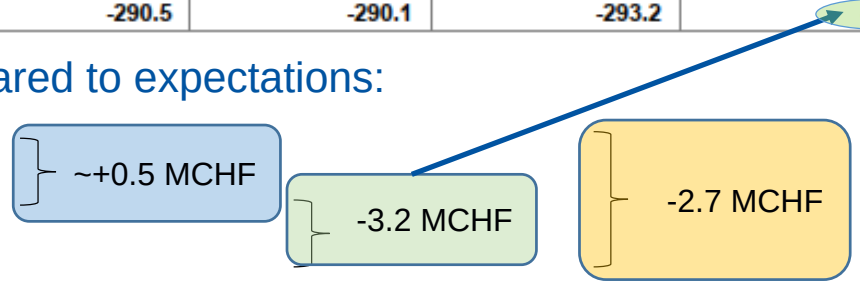
			Previous FS
Accelerator programme	1	LHC machine	1
	2	SPS complex	12b
	3	PS complex	12a, 13
	4	Accelerator support	12c
Experiments and reserach programme	5	ATLAS	2
	6	CMS	3
	7	LHCb	5
	8	ALICE	4
	9	Other LHC experiments	6
	10	Scientific diversity programme	8
	11	Theory	9
	12	Scientific computing	7
	13	Scientific support	11
Infrastructure and services	14	Safety, health and environment	16
	15	Site facilities	14, 19
	16	Technical infrastructure	14, 12c
	17	Informatics and computing infrastructure	15
	18	Administration	17, 15
	19	External relations	18, 10
	20	Centralised expenses	20
Projects	21	LHC injectors upgrade	21
	22	HL-LHC upgrade	22
	23	LHC detectors upgrades	23
	24	Energy frontier studies	24, 25, 26
	25	Accelerator technologies and R&D	27, 30, 31
	26	R&D for future detectors	no factsheet as the heading starts in 2020
	27	Scientific diversity projects	28, 29, 32

Budget position of the Organization

(in MCHF, rounded off)	Final 2018 Budget CERN/FC/6171[3] (2018 prices)	Revised 2018 Budget CERN/FC/6232 (2018 prices)	2018 Out-Turn CERN/FC/6309/Rev. (2018 prices)	Variation of 2018 Out-Turn with respect to Revised 2018 Budget	
				MCHF	%
		(a)	(b)	(c)=(b)-(a)	(c)/(a)
REVENUES	**1 230.2**	**1 266.2**	**1 271.5**	**5.3**	**0.4%**
Member States' contributions	1 122.9	1 122.9	1 122.9	0.0	0.0%
Associate Member States' contributions	24.3	25.3	25.3	0.0	0.0%
Contributions anticipated from new Associate Member States	1.0				
EU contributions	11.9	18.0	16.1	-1.9	-10.8%
Other revenues[1]	70.0	100.0	107.2	7.3	7.3%
EXPENSES	**1 268.8**	**1 304.3**	**1 312.8**	**8.5**	**0.7%**
Scientific programmes	526.6	522.2	513.9	-8.2	-1.6%
Infrastructure and services	290.9	302.9	297.5	-5.4	-1.8%
Centralised expenses[1]	183.2	200.9	209.6	8.6	4.3%
Projects and studies	268.1	278.4	291.8	13.4	4.8%
BALANCE					
Annual balance	-38.6	-38.1	-41.3	-3.2	
Capital repayment allocated to the budget (Fortis, FIPOI 1, 2 and 3)	-26.8	-26.8	-26.8	0.0	
Recapitalisation Pension Fund	-60.0	-60.0	-60.0		
Annual balance allocated to budget deficit	-125.3	-124.9	-128.1	-3.2	
-Cumulative balance[2]- - 165.1	**-290.5**	**-290.1**	**-293.2**	-3.2	

Cumulative budget deficit **remains stable** compared to expectations:

Planned**:** -290.5 MCHF in Final 2018 Budget
Revised: -290.1 MCHF in Revised 2018 Budget
Actual amount: **-293.2** MCHF



A big **thank you** to the External Auditors (National Audit Office of Finland) and to the Delegates for their suggestions and review.

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Facts and key performance indicators: including the trend over 2016-2018

	2018	2017	2016
ACCELERATORS			
LHC pp run			
Peak luminosity	2 x 10^{34} cm^{-2} s^{-1}	2 x 10^{34} cm^{-2} s^{-1}	1.5 x 10^{34} cm^{-2} s^{-1}
Fraction of time in stable beams	*49%*	49%	49%
Integrated luminosity			
ATLAS	65 fb^{-1}	51 fb^{-1}	39 fb^{-1}
CMS	67 fb^{-1}	51 fb^{-1}	40 fb^{-1}
LHCb	2.5 fb^{-1}	2 fb^{-1}	2 fb^{-1}
ALICE	27 pb^{-1}	19 pb^{-1}	13 pb^{-1}
LHC Pb-Pb run			
Peak luminosity			
ATLAS and CMS	6 x 10^{27} cm^{-2} s^{-1}		
LHCb	1.21 x 10^{27} cm^{-2} s^{-1}		
ALICE (levelled)	1 x 10^{27} cm^{-2} s^{-1}		
Fraction of time in stable beams	*51%*		
Integrated luminosity			
ATLAS	1.797 nb^{-1}		
CMS	1.802 nb^{-1}		
LHCb	0.235 nb^{-1}		
ALICE	0.905 nb^{-1}		
Injectors: beam availability			
Linac2	99%	99%	97%
PS Booster	95%	97%	95%
PS Machine	90%	93%	90%
AD (Anti-Proton deaccelerator)	64%	94%	89%
Linac3 (during ion run)	95%	99%	na
LEIR (during ion run)	94%	97%	na
SPS Machine	80%	91%	76%
EXPERIMENTS and THEORY			
Publications			
ATLAS	103	113	106
CMS	141	132	110
ALICE	25	29	24
LHCb	41	60	68
Theory papers with at least one CERN author	342	284	262
Non-LHC experiments	112	178	
PhD students			
ATLAS	1 234	1 198	1 133
CMS	973	908	819
ALICE	363	371	254
LHCb	315	285	276
Non-LHC experiments	294	383	
LHC COMPUTING			
Detector data recorded	84 PB	39 PB	49 PB
Global data transfer rates	50 GB/s	35 GB/s	35 GB/s
Number of jobs per day	2 million	2.2 million	2 million

Full production year

	2018	2017	2016
SAFETY, HEALTH and ENVIRONMENT PROTECTION			
Occupational accidents			
Total number	31	29	32
Accidents at work	16	13	18
Commuting accidents	15	16	14
Radioactive waste			
Received	575	920	316
Eliminated	1 021	3 017	1 200
Stored	6 070	6 516	8 613
OUTREACH			
Protocol visits	120	136	142
Visitors at CERN			
Visits	6 419	5 692	5 048
Participants			
Requested	280 770	236 431	200 688
Received	135 159	135 949	119 985
S'Cool LAB visitors	7 540	7 240	5 877
CERN Teacher Programme			
Number of programmes	33	33	35
Number of participants	906	952	953
Travelling exhibitions			
Number of visitors	~138 000	~400 000	~100 000
Number of visited countries	5	3	7
On-site exhibitions visitors	~100 000	~100 000	~70 000
Press			
Number of media visits	202	214	242
Number of journalists	431	527	628
Press cutting	~166 000	~138 000	~145 000
Mentions on social media	~1.6 million	~2 million	~1.7 million
Website: number of visitors	~ 3.5 million	> 5 million	~ 4 million

Facts and key performance indicators

	2018	2017	2016
REVENUES			
Percentage of outstanding revenues			
Member States	0.2	0.2	1.6
Associate Member States	0.0	0.0	4.2
Associate Member States in the pre-stage to Membership	0.0	0.0	15.3
Percentage of contributions received on time			
Member States	98.5	98.0	86.2
Associate Member States	66.6	43.3	74.6
Associate Member States in the pre-stage to Membership	63.8	49.5	0.0
PROCUREMENT & KNOWLEDGE TRANSFER			
Orders			
Invitations to tenders (>200 kCHF)	80	98	93
Number of orders			
>= 200 kCHF	134	137	120
between 1 and 200 kCHF	12 327	12 150	12 693
< 1 kCHF	11 725	11 914	12 495
Total kCHF of adjudications	382 485	270 189	291 273
Industrial return			
Balanced countries for supplies	10	9	5
Balanced countries for industrial services	6	6	6
Very poorly balanced countries for supplies	8	8	8
Poorly balanced countries for industrial services	24	23	21
Knowledge transfer			
KT contracts signed	44	41	42

	2018	2017	2016
HUMAN RESOURCES			
Resources			
FTE paid on CERN budget (excl. Teams)	2 530	2 476	2 439
Fellows	839	807	750
Associates for the purpose of training			
Administrative students	26	30	35
Apprentices	20	22	20
Doctoral students	227	204	190
Summer students	315	295	278
Technical students	156	182	193
Trainees	118	141	114
Scientific Associates	40	49	43
Project Associates	293	255	188
Users	12 569	12 255	11 856
Visiting scientists hosted by the Theory Department	518	499	476
Staff Recruitment			
Vacancies published	126	184	158
Applications received	12 339	13 835	12 192
Fraction of LD contracts	34%	33%	31%
Training			
Courses	234	248	251
Sessions	507	535	508
Training days	13 403	12 659	13 700
Participants	5 244	6 002	5 800

Green paper

Variation of revenues

(in MCHF, rounded off)	Final 2018 Budget CERN/FC/6171 (2018 prices)	Revised 2018 Budget CERN/FC/6232 (2018 prices)	2018 Out-Turn CERN/FC/6309/RA (2018 prices)	Variation of 2018 Out-Turn with respect to Revised 2018 Budget	
				MCHF	%
		(a)	(b)	(c)=(b)-(a)	(c)/(a)
REVENUES	**1 230.2**	**1 266.2**	**1 271.5**	**5.3**	**0.4%**
Member States' contributions	1 122.9	1 122.9	1 122.9	0.0	0.0%
Associate Member States' contributions	24.3	25.3	25.3	0.0	0.0%
Contributions anticipated from new Associate Member States	1.0				
EU contributions	11.9	18.0	16.1	-1.9	-10.8%
Additional contributions	1.5	6.1	5.4	-0.6	-10.4%
for HIE-ISOLDE, ELENA, AWAKE, FAIR	*1.5*	*6.1*	*5.4*	*-0.6*	*-10.4%*
Personnel paid from team accounts	11.3	11.3	12.9	1.5	13.6%
Personnel on detachment	0.4	0.4	0.5	0.0	11.3%
Internal taxation	33.0	33.0	34.6	1.5	4.7%
Knowledge transfer	1.7	2.0	2.1	0.1	4.6%
Other revenues	22.1	47.1	51.8	4.7	9.9%
Sales and miscellaneous[1]	*6.5*	*26.5*	*32.9*	*6.4*	*24.2%*
SCOAP3 revenues	*4.7*	*8.8*	*8.5*	*-0.3*	*-2.9%*
OpenLab revenues	*0.8*	*1.8*	*1.8*	*-0.0*	*-0.2%*
Financial revenues	*2.0*	*2.0*	*0.8*	*-1.2*	*-61.9%*
In-kind[2]	*2.0*	*2.0*	*1.7*	*-0.3*	*-14.8%*
Housing fund	*6.0*	*6.0*	*6.0*	*0.0*	*0.7%*

The miscellaneous line includes revenue corresponding to materials expenses recharged to teams and collaboration (19.4 MCHF) since end of 2017. Increase due to sponsoring, grants for school, conference revenues, etc.

The increase in the SCOAP3 revenues (already in the Revised 2018 Budget) is due to the signing of the agreement with the American Physical Society (APS).

Variation of expenses

(in MCHF, rounded off)	Final 2018 Budget CERN/FC/6171[3] (2018 prices)	Revised 2018 Budget CERN/FC/6232 (2018 prices)	2018 Out-Turn CERN/FC/6309/Rev. (2018 prices)	Variation of 2018 Out-Turn with respect to Revised 2018 Budget	
				MCHF	%
		(a)	(b)	(c)=(b)-(a)	(c)/(a)
EXPENSES	**1 268.8**	**1 304.3**	**1 312.8**	**8.5**	**0.7%**
Running of scientific programmes and support	**1 000.7**	**1 026.0**	**1 021.0**	**-5.0**	**-0.5%**
Scientific programmes	**526.6**	**522.2**	**513.9**	**-8.2**	**-1.6%**
LHC (machine, detectors and computing, including spares and cor	*267.2*	*260.0*	*268.3*	*8.3*	*3.2%*
Non-LHC physics and scientific support	*86.1*	*86.2*	*78.3*	*-7.9*	*-9.1%*
Other accelerators and areas (including consolidation)	*173.4*	*175.9*	*167.3*	*-8.7*	*-4.9%*
Infrastructure and services	**290.9**	**302.9**	**297.5**	**-5.4**	**-1.8%**
General infrastructure and services (incl. admin, international relati	*259.6*	*270.0*	*265.0*	*-5.0*	*-1.8%*
Infrastructure consolidation, buildings and renovation	*31.3*	*32.9*	*32.5*	*-0.4*	*-1.3%*
Centralised expenses	**183.2**	**200.9**	**209.6**	**8.6**	**4.3%**
Centralised personnel expenses	*36.3*	*36.3*	*36.8*	*0.4*	*1.2%*
Internal taxation	*33.0*	*33.0*	*34.6*	*1.5*	*4.7%*
Inter. mobility, personnel on detach., paid but not available or paid	*11.7*	*12.0*	*19.7*	*7.7*	*63.7%*
Budget amortisation of staff benefit accruals	*17.3*	*17.3*	*17.3*	*0.0*	*0.0%*
Energy and water, insurance and postal charges, miscellaneous	*73.4*	*90.9*	*91.1*	*0.2*	*0.2%*
Interest, bank and financial expenses, in-kind[1]	*11.3*	*11.3*	*10.1*	*-1.2*	*-10.6%*
Projects and studies	**268.1**	**278.4**	**291.8**	**13.4**	**4.8%**
LHC upgrades	**200.6**	**206.5**	**213.2**	**6.7**	**3.3%**
LHC injectors upgrade	*55.6*	*56.1*	*51.8*	*-4.3*	*-7.6%*
HL-LHC construction	*103.0*	*107.8*	*114.0*	*6.2*	*5.7%*
LHC detectors upgrade (Phase I) and consolidation	*24.7*	*25.3*	*27.0*	*1.7*	*6.8%*
HL-LHC detectors, including R&D (Phase II)	*17.3*	*17.3*	*20.4*	*3.1*	*17.9%*
Preparation for the future	**35.8**	**39.2**	**38.7**	**-0.5**	**-1.3%**
Linear collider studies (CLIC, ILC, detector R&D)	*17.2*	*16.2*	*15.8*	*-0.4*	*-2.3%*
Future Circular Collider study	*13.8*	*16.8*	*16.4*	*-0.4*	*-2.1%*
High-energy frontier					
Proton-driven plasma wakefield acceleration (AWAKE)	*3.0*	*4.1*	*3.8*	*-0.3*	*-8.3%*
Physics Beyond Colliders study	*1.7*	*2.2*	*2.7*	*0.5*	*25.2%*
Scientific diversity activities	**31.7**	**32.7**	**40.0**	**7.3**	**22.2%**
CERN Neutrino Platform	*15.9*	*12.4*	*17.4*	*5.1*	*40.9%*
R&D (incl. EU support) for accelerators	*15.8*	*20.4*	*22.6*	*2.2*	*10.8%*
BALANCE					
Annual balance	-38.6	-38.1	-41.3	-3.2	
Capital repayment allocated to the budget (Fortis, FIPOI 1, 2 and 3)	-26.8	-26.8	-26.8	0.0	
Recapitalisation Pension Fund	-60.0	-60.0	-60.0		
Annual balance allocated to budget deficit	-125.3	-124.9	-128.1	-3.2	
-Cumulative balance[2]- - 165.1	**-290.5**	**-290.1**	**-293.2**	**-3.2**	

The preparation of LS2 led to a higher level of expenses for some consolidation headings (LHC spares, LHC consolidation, electrical network consolidation, LHC diodes consolidation) and some LS2-related projects such as SPS fire safety and cooling towers at Point 1&8.

Some expenses for the AD consolidation and the East Area renovation were already re-profiled in the 2018 probable expenses.

The miscellaneous item under the heading energy and water, includes the materials expenses (19.4 MCHF) recharged to team accounts that were shown separately for the first time in 2017.

The schedule variance of 2.2 months mentioned in the EVM reports on the LHC Injectors Upgrade explains the lower level of expenses for the LIU project.

The focus on the LHC upgrades resulted in a slightly ahead-of-the-schedule progress with correspondingly higher expenses for the HL-LHC and the detector upgrades.

Higher expenses for the Neutrino Platform are explained by the completion of the infrastructure works in EHN1 as well as cryogenic supplies and other cryostat infrastructure.