Appendices

Appendix A: The List of ISO/IEC 9126 Base Measures

	Measure Name	Unit of Measurement
	External Base Measures	
1	Number of Functions	Function (number of)
2	Operation Time	Minute
3	Number of Inaccurate Computations Encountered by Users	Case (number of)
4	Total Number of Data Formats	Format (number of)
5	Number of Illegal Operations	Operation (number of)
6	Number of Items Requiring Compliance	Item (number of)
7	Number of Interfaces Requiring Compliance	Interface (number of)
8	Number of Faults	Fault (number of)
9	Number of Failures	Failure (number of)
10	Product Size	Byte
11	Number of Test Cases	Case (number of)
12	Number of Breakdowns	Breakdown (number of)
13	Time to Repair	Minute
14	Down Time	Minute
15	Number of Restarts	Restart (number of)
16	Number of Restoration Required	Restoration (number of)
17	Number of Tutorials	Tutorial (number of)
18	Number of I/O Data Items	Item (number of)
19	Ease of Function Learning	Minute
20	Number of Tasks	Task (number of)
21	Help Frequency	Access (number of)
22	Error Correction	Minute
23	Number of Screens or Forms	Screens (number of)
24	Number of User Errors or Changes	Error (number of)
25	Number of Attempts to Customize	Attempt (number of)
26	Total Number of Usability Compliance Items Specified	Item (number of)
27	Response Time	Second or Millisecond
28	Number of Evaluations	Evaluation (number of)
29	Turnaround Time	Second or Millisecond
30	Task Time	Minute
31	Number of I/O Related Errors	Error (number of)
32	User Waiting Time of I/O Device Utilization	Second or Millisecond
33	Number of Memory Related Errors	Error (number of)
34	Number of Transmission Related Errors	Error (number of)
35	Transmission Capacity	Byte
36	Number of Revised Versions	Version (number of)
37	Number of Resolved Failures	Failure (number of)
38	Porting User Friendliness	Minute

Internal Base Measures

	Measure Name	Unit of Measurement
1	Number of Functions	Function (number of)
2	Number of Data Items	Item (number of)
3	Number of Data Formats	Formats (number of)
4	Number of Interface Protocols	Protocol (number of)
5	Number of Access Types	Access-Type (number of)
6	Number of Access Controllability Requirements	Requirement (number of)
7	Number of Instances of Data Corruption	Instance (number of)
8	Number of Compliance Items	Item (number of)
9	Number of Interface Requiring Compliance	Interface (number of)
10	Number of Faults	Fault (number of)
11	Number of Test Cases	Test-Case (number of)
12	Number of Restoration	Requirement (number of)
13	Number of Input Items Which Could Check for Valid Data	Item (number of)
14	Number of Operations	Operation (number of)
15	Number of Messages Implemented	Message (number of)
16	Number of Interface Elements	Element (number of)
17	Response Time	Second or Millisecond
18	Turnaround Time	Second or Millisecond
19	I/O Utilization (Number of Buffers)	Buffer (number of)
20	Memory Utilization	Byte
21	Number of Lines of Code Directly Related to System Calls	Line (number of)
22	Number of I/O Related Errors	Error (number of)
23	Number of Memory Related Errors	Error (number of)
24	Number of Items Required to be Logged	Item (number of)
25	Number of Modifications Made	Modification (number of)
26	Number of Variables	Variable (number of)
27	Number of Diagnostic Functions Required	Function (number of)
28	Number of Entities	Entity (number of)
29	Number of Built-in Test Function Required	Function (number of)
30	Number of Test Dependencies on Other System	Dependency (number of)
31	Number of Diagnostic Checkpoints	Checkpoint (number of)
32	Number of Data Structures	Data-Structure (number of)
33	Total Number of Setup Operations	Operation (number of)
34	Number of Installation Steps	Step (number of)

Quality in use Base Measures

	Measure Name	Unit of Measurement
1	Task Effectiveness	(a given weight)
2	Total Number of Tasks	Task (number of)
3	Task Time	Minute
4	Cost of the Task	Dollar
5	Help Time	Second
6	Error Time	Second
7	Search Time	Second
8	Number of Users	User (number of)
9	Total Number of People Potentially Affected by the System	Person (number of)
10	Total Number of Usage Situations	Situation (number of)

The Cross-Reference Table of ISO/IEC 9126 Base Measure Usages.

	Measure Name	Unit	External																											Internal																											Quality in use			
			Functionality					Reliability				Usability					Efficiency			Maintainability					Portability					Functionality					Reliability				Usability					Efficiency			Maintainability					Portability								
			F1	F2	F3	F4	F5	R1	R2	R3	R4	U1	U2	U3	U4	U5	E1	E2	E3	M1	M2	M3	M4	M5	P1	P2	P3	P4	P5	F1	F2	F3	F4	F5	R1	R2	R3	R4	U1	U2	U3	U4	U5	E1	E2	E3	M1	M2	M3	M4	M5	P1	P2	P3	P4	P5	Q 1	Q 2	Q 3	Q
1	Number of Functions	Function	☞									☞	☞	☞											☞			☞		☞	☞					☞			☞	☞	☞							☞				☞		☞						
2	Operation Time	Minute		☞	☞	☞		☞		☞			☞	☞			☞	☞			☞	☞	☞		☞		☞																																	
3	Number of Inaccurate Computations Encountered by Users	Case		☞																																																								
4	Number of Data Formats	Format			☞																											☞																												
5	Number of Illegal Operations	Operation				☞																														☞																								
6	Number of Items Requiring Compliance	Item					☞				☞					☞			☞					☞					☞					☞				☞					☞			☞					☞					☞				
7	Number of Interfaces Requiring Compliance	Interface					☞																											☞																										
8	Number of Faults	Fault						☞																	☞	☞																																		
9	Number of Failures	Failure						☞	☞									☞		☞		☞					☞																																	
10	Product Size	Byte						☞																																																					
11	Number of Test Cases	Case				☞		☞	☞														☞												☞																									
12	Number of Breakdowns	Breakdown							☞	☞																																																		
13	Time to Repair	Minute								☞																																																		
14	Down Time									☞																																																		
15	Number of Restarts	Restart								☞																																																		
16	Number of Restoration	Restoration								☞																											☞																								

Legend of the Quality in Use characteristics

Q1	Effectiveness
Q2	Productivity
Q3	Safety
Q4	Satisfaction

Legend of the External and Internal sub-characteristics

F1	Suitability	E1	Time Behavior
F2	Accuracy	E2	Resource Utilization
F3	Interoperability	E3	Efficiency Compliance
F4	Security	M1	Analyzability
F5	Functionality Compliance	M2	Changeability
R1	Maturity (Hardware/Software/Data)	M3	Stability
R2	Fault Tolerance	M4	Testability
R3	Recoverability (Data/Process/Technology)	M5	Maintainability Compliance
R4	Reliability Compliance	P1	Adaptability
U1	Understandability	P2	Instability
U2	Learnability	P3	Co-existence
U3	Operability	P4	Replaceability
U4	Attractiveness	P5	Portability Compliance
U5	Usability Compliance		

Appendix B

Table B1: External Quality – ISO TR 9126-2 and ISO DTR 25021

Quality Characteristics	Quality Subcharacteristics		Measure Names	ISO DTR 25021	ISO 9126-2
Functionality	Accuracy	1	Computational accuracy	√	√
		2	Precision	√	√
		3	Accuracy relative to expectations		√
	Interoperability	4	Data exchangeability (Data format-based)	√	√
		5	Data exchangeability (User's success, attempt-based)		√
	Security	6	Access controllability	√	√
		7	Access auditability		√
		8	Data corruption prevention		√
	Suitability	9	Funcional implementation completeness	√	√
		10	Functional adequacy	√	√
		11	Functional implementation coverage	√	√
		12	Functional specification stability (volatility)		√
	Functionality Compliance	13	Functional compliance		√
		14	Interface standard compliance		√
Reliability	Maturity	15	Failure density against test cases	√	√
		16	Failure resolution	√	√
		17	Fault removal	√	√
		18	Mean time between failures (MTBF)	√	√
		19	Test maturity	√	√
		20	Estimated latent fault density	√	√
		21	Fault density	√	√
		22	Test coverage (Specified operation scenario testing coverage)		√
	Recoverability	23	Restartability	√	√
		24	Availability		√
		25	Mean down time		√
		26	Mean recovery time		√
		27	Restorability		√
		28	Restore effectiveness		√
	Fault Tolerance	29	Breakdown avoidance		√
		30	Failure avoidance		√
		31	Incorrect operation avoidance		√
	Reliability Compliance	32	Reliability compliance		√
Usability	Learnability	33	Effectiveness of the user documentation and/or help system	√	√
		34	Help accessibility	√	√
		35	Ease of function learning		√
		36	Ease of learning to perform a task in use		√
		37	Effectiveness of user documentation and/or help system in use		√
		38	Help frequency		√
	Operability	39	Physical accessibility	√	√
		40	Operational consistency in use		√

Quality Characteristics	Quality Subcharacteristics		Measure Names	ISO DTR 25021	ISO 9126-2
		41	Error correction		√
		42	Error correction in use		√
		43	Default value availability in use		√
		44	Message understandability in use		√
		45	Self-explanatory error messages		√
		46	Operational error recoverability in use		√
		47	Time between human error operations in use		√
		48	Undoability (User error correction)		√
		49	Customizability		√
		50	Operation procedure reduction		√
	Understandability	51	Completeness of description	√	√
		52	Function understandability	√	√
		53	Understandable input and output	√	√
		54	Demonstration accessibility		√
		55	Demonstration accessibility in use		√
		56	Demonstration effectiveness		√
		57	Evident functions		√
	Attractiveness	58	Attractive interaction		√
		59	Interface appearance customizability		√
	Usability Compliance	60	Usability compliance		√
Efficiency	Resource Utilization	61	I/O loading limits	√	√
		62	Maximum memory utilization	√	√
		63	Maximum transmission utilization	√	√
		64	Mean occurrence of transmission error	√	√
		65	I/O device utilization		√
		66	I/O-related errors		√
		67	Mean I/O fulfillment ratio		√
		68	User waiting time of I/O device utilization		√
		69	Mean occurrence of memory errors		√
		70	Ratio of memory error/time		√
		71	Media device utilization balancing		√
		72	Mean transmission error per time		√
		73	Transmission capacity utilization		√
	Time Behavior	74	Response time (Mean time to respond)	√	√
		75	Throughput (Mean amount of throughput)	√	√
		76	Turnaround time (Mean time for turnaround)	√	√
		77	Response time		√
		78	Response time (Worst case response time ratio)		√
		79	Throughput		√
		80	Throughput (Worst case throughput time ratio)		√
		81	Turnaround time		√
		82	Turnaround time (Worst case turnaround time ratio)		√
		83	Waiting time		√

Quality Characteristics	Quality Subcharacteristics		Measure Names	ISO DTR 25021	ISO 9126-2
	Efficiency Compliance	84	Efficiency compliance		√
Maintainability	Analyzability	85	Audit trail capability	√	√
		86	Diagnostic function support		√
		87	Failure analysis capability		√
		88	Failure analysis efficiency		√
		89	Status monitoring capability		√
	Changeability	90	Software change control capability	√	√
		91	Change cycle efficiency		√
		92	Change implementation elapsed time		√
		93	Modification complexity		√
		94	Parameterized modifiability		√
	Stability	95	Change success ratio		√
		96	Modification impact localization (Emerging failure after change)		√
	Testability	97	Availability of built-in test function		√
		98	Retest efficiency		√
		99	Test restartability		√
	Maintainability Compliance	100	Maintainability compliance		√
Portability	Adaptability	101	Adaptability of data structures	√	√
		102	Hardware environmental adaptability (adaptability to hardware devices and network facilities)	√	√
		103	System software environmental adaptability (adaptability to OS, network software and cooperated application software)	√	√
		104	Organizational environment adaptability (Organization adaptability to infrastructure of organization)		√
		105	Porting user-friendliness		√
	Installability	106	Ease of installation	√	√
		107	Ease of setup retry		√
	Coexistance Replaceability	108	Availability coexistence		√
	Replaceability	109	Continued use of data		√
		110	Function inclusiveness		√
		111	User support functional consistency		√
	Portability Compliance	112	Portability Compliance		√

Table B2: Internal Quality – ISO TR 9126-3 and ISO DTR 25021

Quality Characteristics	Quality Subcharacteristics		Measure Names	ISO DTR 25021	ISO 9126-3
Functionality	Accuracy	1	Computational accuracy	√	√
		2	Precision	√	√
	Interoperability	3	Data exchangeability (Data format-based)	√	√
		4	Interface consistency (protocol)		√
	Security	5	Access controllability	√	√
		6	Access auditability		√
		7	Data corruption prevention		√
		8	Data encryption		√
	Suitability	9	Funcional implementation completeness	√	√
		10	Functional adequacy	√	√
		11	Functional implementation coverage	√	√
		12	Functional specification stability (volatility)		√
	Functionality Compliance	13	Functional compliance		√
		14	Intersystem standard compliance		√
Reliability	Maturity	15	Fault removal	√	√
		16	Fault detection		√
		17	Test adequacy		√
	Recoverability	18	Restorability		√
		19	Restoration effectiveness		√
	Fault Tolerance	20	Failure avoidance		√
		21	Incorret operation avoidance		√
	Reliability Compliance	22	Reliability Compliance		√
Usability	Learnability	23	Completeness of user documentation and/or help facility	√	√
	Operability	24	Physical accessibility	√	√
		25	Input validity checking		√
		26	User operation cancellability		√
		27	User operation undoability		√
		28	Customizability		√
		29	Operation status monitoring capability		√
		30	Operational consistency		√
		31	Message clarity		√
		32	Interface element clarity		√
		33	Operational error recoverability		√
	Understandability	34	Completeness of description	√	√
		35	Function understandability	√	√
		36	Demonstration capability		√
		37	Evident functions		√
	Attractiveness	38	Attractive interaction		√
		39	User interface appearance customizability		√
	Usability Compliance	40	Usability Compliance		√
Efficiency	Resource Utilization	41	I/O utilization		√
		42	I/O utilization message density		√
		43	Memory utilization		√
		44	Memory utilization message density		√

Quality Characteristics	Quality Subcharacteristics		Measure Names	ISO DTR 25021	ISO 9126-3
		45	Transmission utilization		√
	Time Behavior	46	Response time		√
		47	Throughput time		√
		48	Turnaround time		√
	Efficiency Compliance	49	Efficiency compliance		√
Maintainability	Analyzability	50	Activity recording		√
		51	Readiness of diagnostic function		√
	Changeability	52	Change recordability		√
	Stability	53	Change impact		√
		54	Modification impact localization		√
	Testability	55	Completeness of built-in test function		√
		56	Autonomy of testability		√
		57	Test progress observability		√
	Maintainability Compliance	58	Maintainability compliance		√
Portability	Adaptability	59	Adaptability of data structures	√	√
		60	Hardware environmental adaptability (adaptability to hardware devices and network facilities)	√	√
		61	System software environmental adaptability (adaptability to OS, network software and cooperated application software)	√	√
		62	Organizational environment adaptability		√
		63	Porting user-friendliness		√
	Installability	64	Ease of setup retry		√
		65	Installation effort		√
		66	Installation flexibility		√
	Co-existence	67	Availability of coexistence		√
	Replaceability	68	Continued use of data		√
		69	Functional inclusiveness		√
	Portability Compliance	70	Portability compliance		√

Table B3: Quality in Use – ISO TR 9126-4 and ISO DTR 25021

Quality Characteristics		Measure Names	ISO DTR 25021	ISO 9126-4
Effectiveness	1	Task effectiveness		√
	2	Task completion	√	√
	3	Error frequency		√
Productivity	4	Task time	√	√
	5	Task efficiency		√
	6	Economic productivity		√
	7	Productive proportion		√
	8	Relative user efficiency		√
Safety	9	User health and safety		√
	10	Safety of people affected by use of the system		√
	11	Economic damage		√
	12	Software damage		√
Satisfaction	13	Satisfaction scale		√
	14	Satisfaction questionnaire		√
	15	Discretionary usage		√