

2019 Model-based Testing User Survey: Results



Anne Kramer
Bruno Legeard

Contents

1	Overview.....	2
1.1	About the 2019 MBT User Survey.....	2
1.2	About this document.....	2
1.3	Result overview	3
1.4	Acknowledgements	3
2	Detailed Results	4
	Question 1: Degree of experience (29 answers)	4
	Question 2: Expectations (29 answers)	5
	Question 3: Does MBT fulfil those expectations? (29 answers)	6
	Question 4: Test level(s) (29 answers)	7
	Question 5: Type(s) of testing (29 answers)	8
	Question 6: Stage of MBT adoption (28 answers).....	9
	Question 7: Use of models in other development phases (28 answers)	10
	Question 8: Type of models in those other development phases (16 answers).....	11
	Question 9: Degree of reuse (15 answers).....	12
	Question 10: Testing effort (23 answer)	13
	Question 11: MBT model focus (23 answers).....	14
	Question 12: Degree of detail in MBT model (23 answers).....	15
	Question 13: Notation type (24 answers)	16
	Question 14: Traceability (23 answers)	17
	Question 15: Generated artifacts (24 answers)	18
	Question 16: Test case generation (23 answers)	19
	Question 17: Selection criteria (23 answers)	20
	Question 18: Test execution (23 answers)	21
	Question 19: Tools integration (22 answers)	22
	Question 20: Role the model plays in MBT approach	23
	Question 21: How effective do you think MBT has been? (24 answers).....	24
	Question 22: How likely are you to continue to use MBT? (24 answers)	25
	Question 23: Biggest limitation of MBT (17 answers).....	26
	Question 24: Biggest advantage of MBT (18 answers)	27
	Question 25: Hours needed to become a proficient MBT user (18 answers).....	28
	Question 26: ISTQB Certified Model-Based Tester (24 answers).....	29
	Question 27: General application domain of the system under test (23 answers)	30
	Question 28: MBT project sponsor (23 answers)	31
	Question 29: Size of organization (19 answers).....	32
	Question 30: Overall process approach (23 answers)	33
	Question 31: Role of respondents (24 answers)	34

1 Overview

1.1 About the 2019 MBT User Survey

This document summarizes the results of the fourth edition of the MBT User Survey, which was conducted from May to December 2019. 29 model-based testing practitioners answered, thus providing an insight into the current state of practice in the MBT area.

The purpose of the survey is to collect data and experience on the usage of Model-based Testing on a regular basis. We want to learn how MBT users view the efficiency and effectiveness of the approach, what works, what does not work and how MBT evolves.

All started in 2011 when Robert V. Binder asked real users of model-based testing about their experiences. In 2014, Bruno Legiard and Anne Kramer augmented the questionnaire with some technical questions on MBT techniques. Since then, the questionnaire remained basically the same to allow better comparison. For those who are interested in previous survey results, here are the links:

[2011/2012 MBT User Survey](#)

[2014 MBT User Survey](#)

[2016/2017 MBT User Survey](#)

The 2019 MBT User Survey is a joint initiative of the French and German Testing Boards.

1.2 About this document

This document contains the results of the 31 questions. For each question, we first provide a graphical representation of the 2019 result followed by data from the last three surveys (2019, 2016/2017 and 2014). The results from 2011/2012 are not listed, because the questionnaire was different at that time.

For numerical answers, we provided both the average and the median. The median indicates the middle of a distribution, that is, the point where there are as many answers below as above. It is less sensitive to extreme answers and usually more informative than the average. MBT tools are out of scope of the survey and, thus, not mentioned in this document.

Please, let us know if you have any comments, question or remarks regarding this MBT User Survey 2019.

Anne Kramer, sepp.med gmbh - anne.kramer@seppmed.de

Bruno Legiard, Smartesting & University of Franche-Comté – bruno.legiard@smartesting.com

1.3 Result overview

In 2019, only 29 volunteers participated in the survey. Most of the questions received 23 or 24 answers. Due to the small number of answers, the 2019 MBT User Survey is of low statistical significance. It is not possible to identify clear trends, if we take the error bars into account.

Nevertheless, the results give an insight into the way MBT is perceived by those who have been practicing it for several years (question 1). We assume that many respondents of the 2019 edition already participated in the 2016/2017 survey.

When comparing the results to those from 2016/2017, we can observe that the expectations regarding MBT are higher than ever (question 2). Surprisingly, the perceived benefits changed from “improved communication” to “earlier test design” (question 3). Possibly, this correlates with the fact that a large majority of participants employs MBT on system testing and acceptance testing level (question 4). Those test levels usually suffer most from project delays, which makes early test design even more important.

The level of detail contained in MBT models increased with respect to the previous years (question 12). Also, the respondents seem to rely more on test case generators for fully automated test generation (question 16). This observation is confirmed by the increased tool integration (question 19).

The general conclusion regarding MBT is much more positive than in previous years. All respondents stated that MBT is efficient, although with varying degrees of satisfaction (question 21). Most of them plan to continue working with MBT (question 22). Only one respondent indicated that his organization has stopped using MBT in favor of automated unit and integration testing as part of continuous integration (question 20).

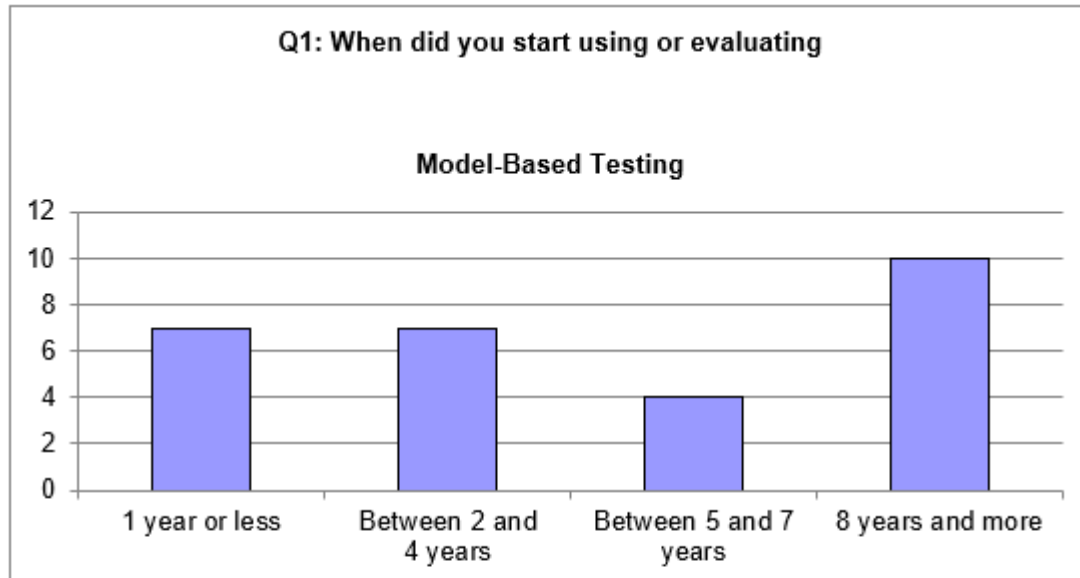
The most significant trend concerns the number of hours required to become a proficient MBT user. The median moved from two weeks (80 hours) in 2014 to three weeks in 2019 (120 hours), thus approaching the average value of 155 hours (question 25).

1.4 Acknowledgements

We wish to thank all those who helped us disseminating the Call for Participation. Our special thanks go to Klaudia Dussa-Zieger and Armin Metzger from the German Testing Board for supporting the initiative. Last, but not least, thanks to all who took the time to answer the questions.

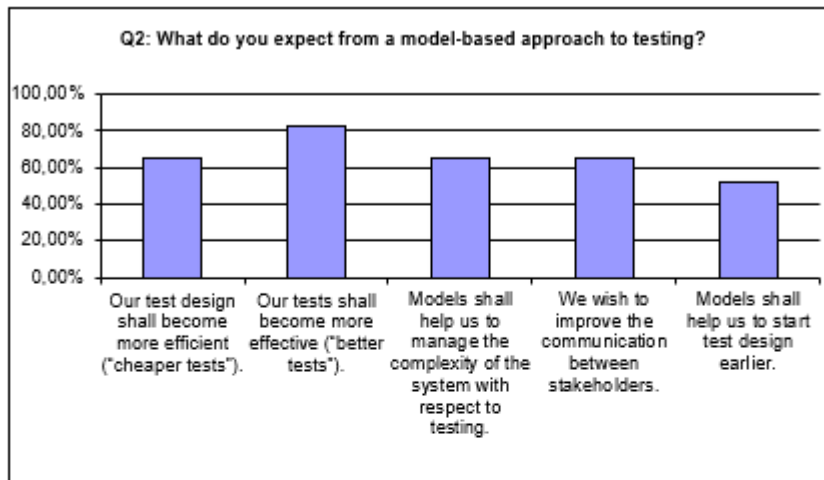
2 Detailed Results

Question 1: Degree of experience (29 answers)



nn years ago	2019	2016	2014
Average	8	5,9	5,1
Median	5	4	3
Minimum value	0	0	0
Maximum value	40	33	34

Question 2: Expectations (29 answers)



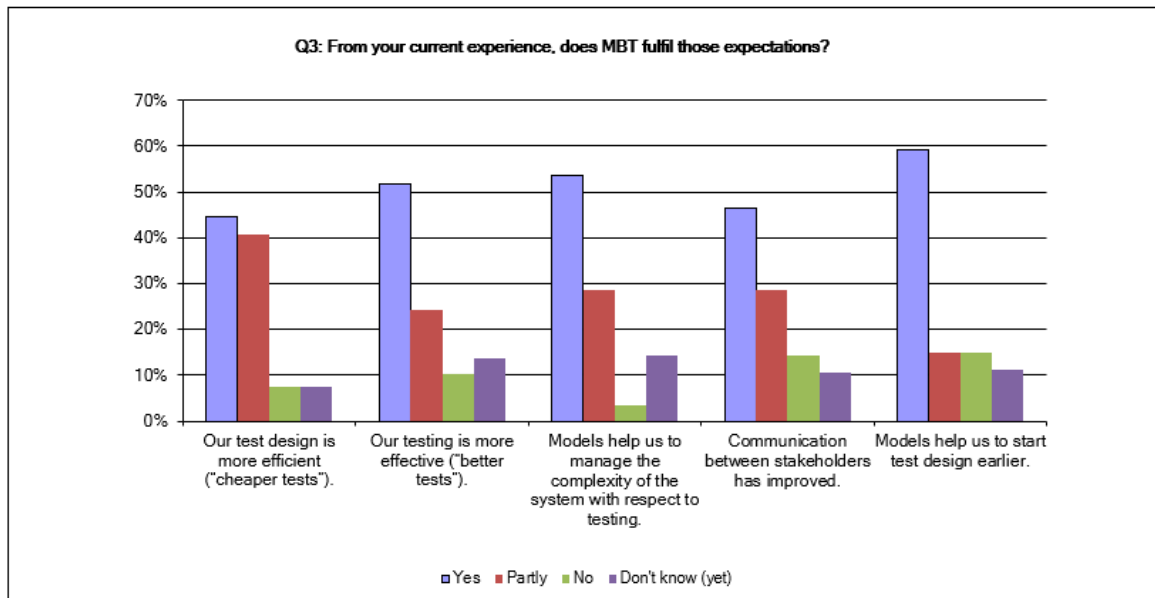
Answer Options

	2019	2016	2014
Our test design shall become more efficient ("cheaper tests").	65,52%	55,7%	73%
Our tests shall become more effective ("better tests").	82,76%	82,0%	86%
Models shall help us to manage the complexity of the system with respect to testing.	65,52%	70,5%	79%
We wish to improve the communication between stakeholders.	65,52%	36,1%	45%
Models shall help us to start test design earlier.	51,72%	45,9%	60%

Other expectations:

- I expected it to make my job as a tester more interesting and satisfying. In essence, to learn something new.
- Find ambiguity in requirements.
- ease and reduce maintenance efforts, give non-technical people the tools to create automated test cases
- ATDD and automation (good architecture for initiate it)
- Use MBT to build automated scripts skeletons using keywords (like RobotFrameWork)
- better systematic, higher test coverage

Question 3: Does MBT fulfil those expectations? (29 answers)



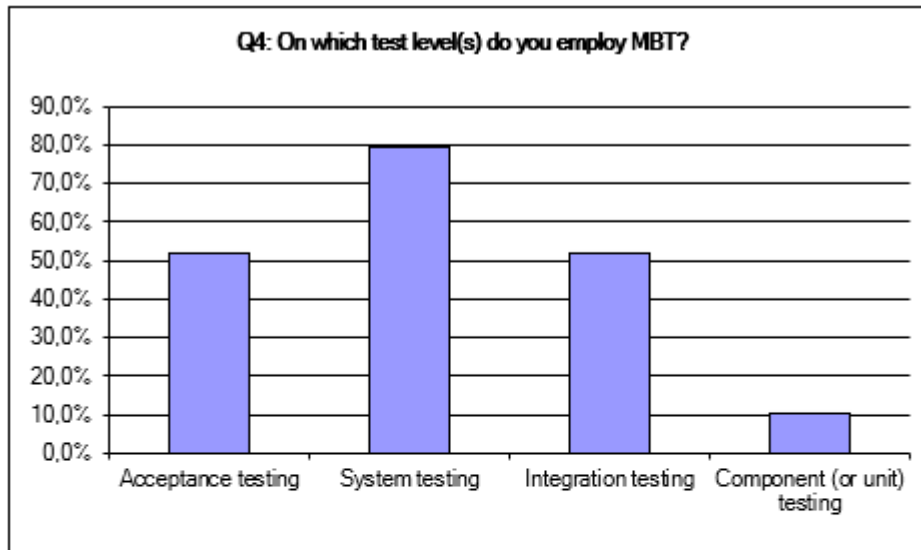
Answer Options	Yes	Partly	No	Don't know (yet)
Our test design is more efficient ("cheaper tests").	44%	41%	7%	7%
Our testing is more effective ("better tests").	52%	24%	10%	14%
Models help us to manage the complexity of the system with respect to testing.	54%	29%	4%	14%
Communication between stakeholders has improved.	46%	29%	14%	11%
Models help us to start test design earlier.	59%	15%	15%	11%

	Yes or Partly			No		
	2019	2016	2014	2019	2016	2014
Our test design is more efficient ("cheaper tests").	85%	70%	68%	7%	10%	15%
Our testing is more effective ("better tests").	76%	77%	77%	14%	7%	8%
Models help us to manage the complexity of the system with respect to testing.	82%	70%	81%	14%	13%	5%
Communication between stakeholders has improved.	75%	63%	59%	11%	15%	15%
Models help us to start test design earlier.	74%	62%	67%	11%	18%	10%

Other answers:

- (Expectation not fulfilled: "Communication between stakeholders has improved.") In the beginning we hoped that we would be able to use the same models for MBT and communication with stakeholders. But - partially because of the tool constraints - we have decided to create two separate types of models for the two purposes. One type is usually activity diagrams without a very strict notation, and it's indeed a wonderful communication tool. The other is state machine diagrams with the content strictly determined by test automation keywords, and some aspects make it difficult for non-testers to read those models. So to sum up, communication has improved thanks to models, but that is not directly connected to MBT.
- My current organization has not adopted MBT yet. I have used it successfully in the past, and have presented a proof of concept project to my organization, there is interest but not yet adoption.
- Better tests: MBT creates more coverage of the system under test [SUT], which might expose bugs, but also exposes other weaknesses of the SUT. Those deficiencies can manifest themselves as test flakiness. That has to be dealt with.
- Based on requirement engineering the the designing start still later as expected
- Using the MBT tool requires a lot of know-how that is most of the time not available (modelling, testing, automation).

Question 4: Test level(s) (29 answers)



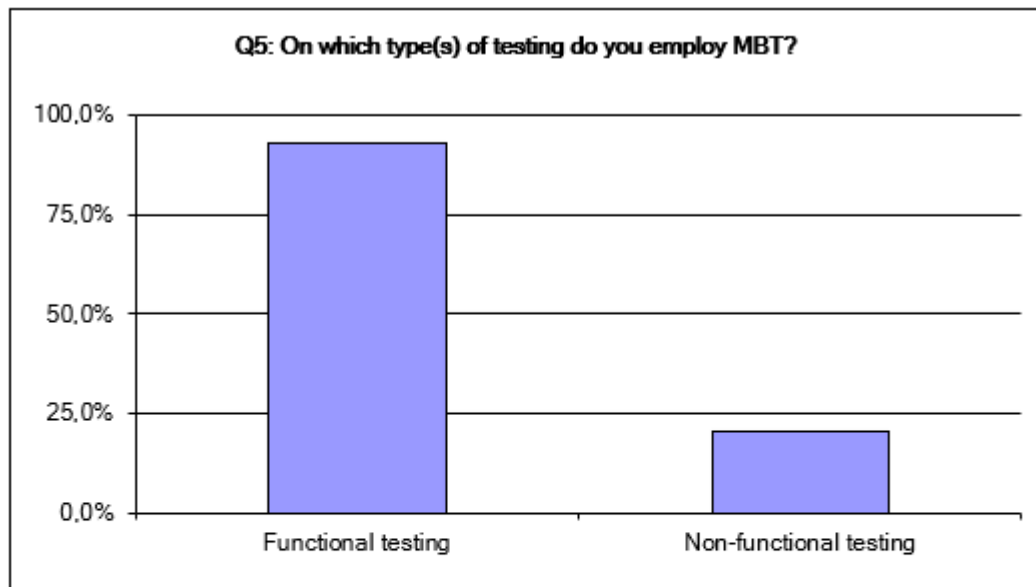
Answer Options

	2019	2016	2014
Acceptance testing	51,7%	37,9%	31,2%
System testing	79,3%	77,6%	49,5%
Integration testing	51,7%	43,1%	77,4%
Component (or unit) testing	10,3%	20,7%	40,9%

Others:

- Just for Academic Research
- NRT, e2e testing

Question 5: Type(s) of testing (29 answers)



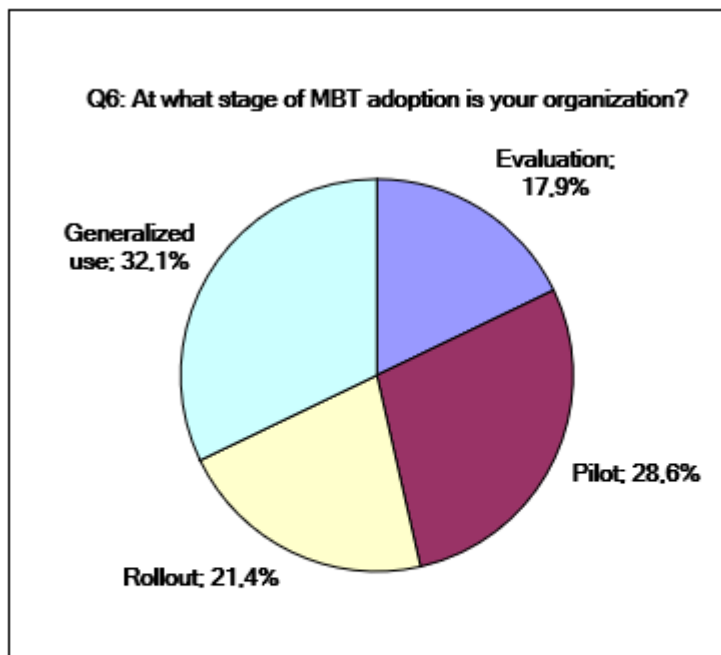
Answer Options

	2019	2016	2014
Functional testing	93,1%	98,3%	98,8%
Non-functional testing	20,7%	22,0%	*)

Details on non-functional testing:

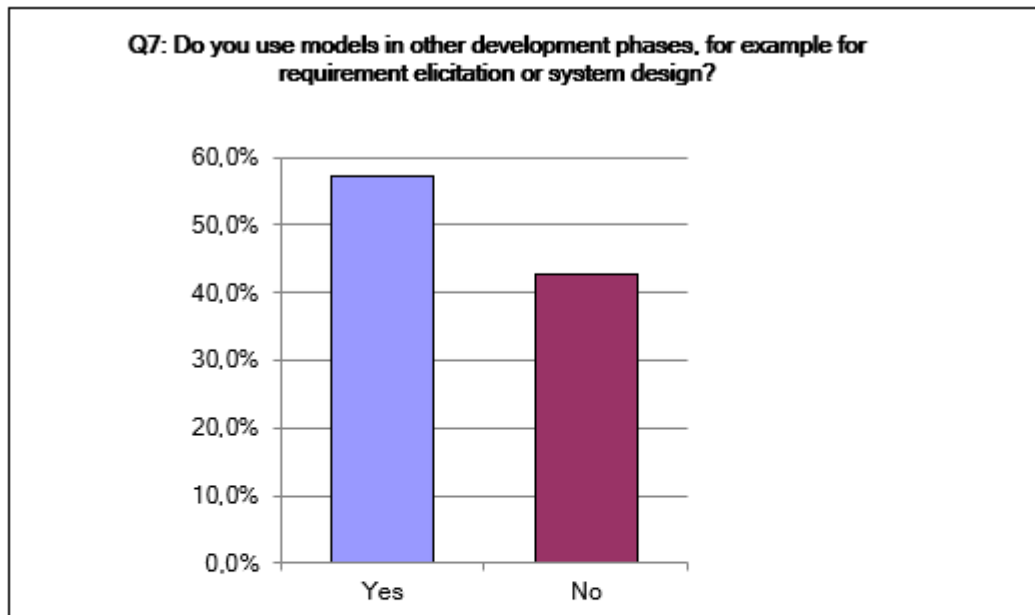
- Reliability testing.
- load testing, cross browser testing
- Performance and security testing

Question 6: Stage of MBT adoption (28 answers)



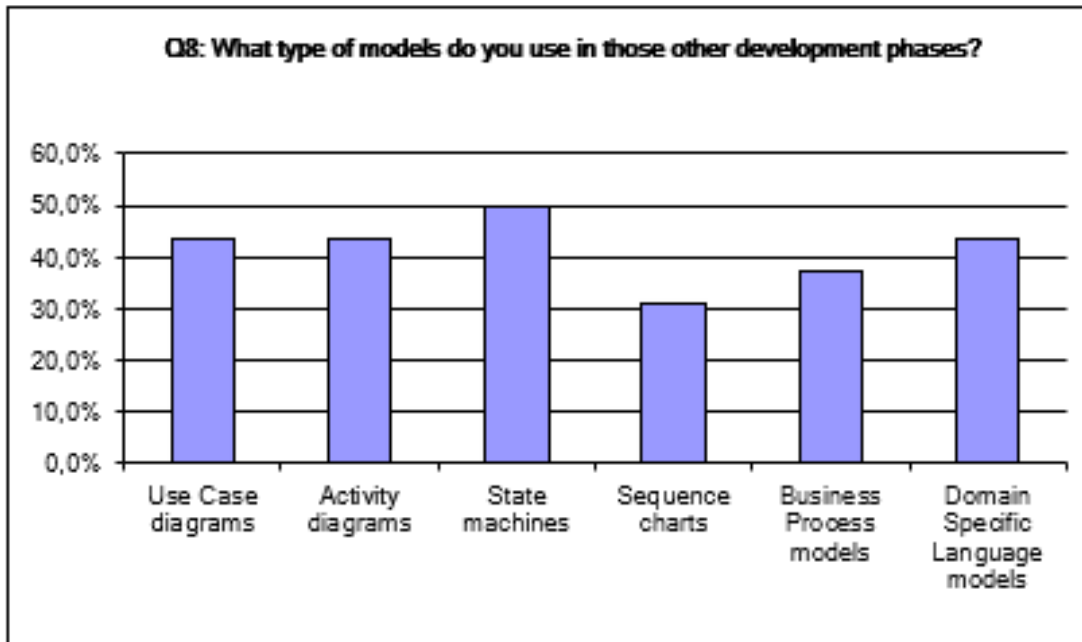
Answer Options	2019	2016	2014
Evaluation	17,9%	33,3%	26,3%
Pilot	28,6%	26,7%	26,3%
Rollout	21,4%	13,3%	16,8%
Generalized use	32,1%	26,7%	30,5%

Question 7: Use of models in other development phases (28 answers)



Answer Options	2019	2016	2014
Yes	57,1%	53,3%	58,9%
No	42,9%	46,7%	41,1%

Question 8: Type of models in those other development phases (16 answers)



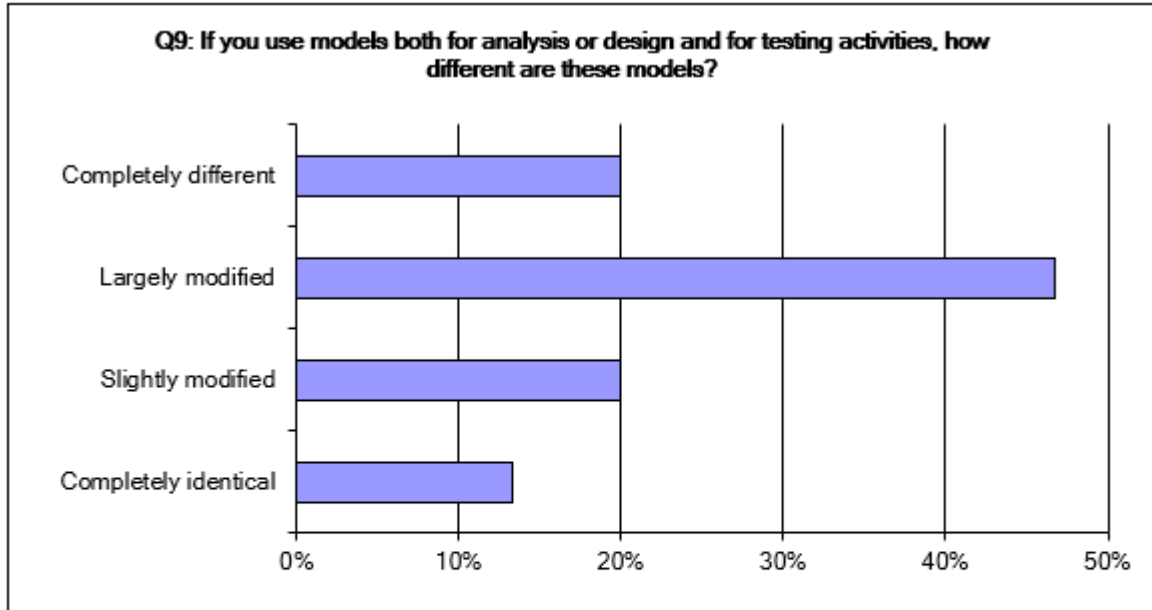
Answer Options

	2019	2016	2014
Use Case diagrams	43,8%	65,6%	65,4%
Activity diagrams	43,8%	53,1%	46,2%
State machines	50,0%	68,8%	69,2%
Sequence charts	31,3%	28,1%	36,5%
Business Process models	37,5%	25,0%	17,3%
Domain Specific Language models	43,8%	25,0%	30,8%

Other answers:

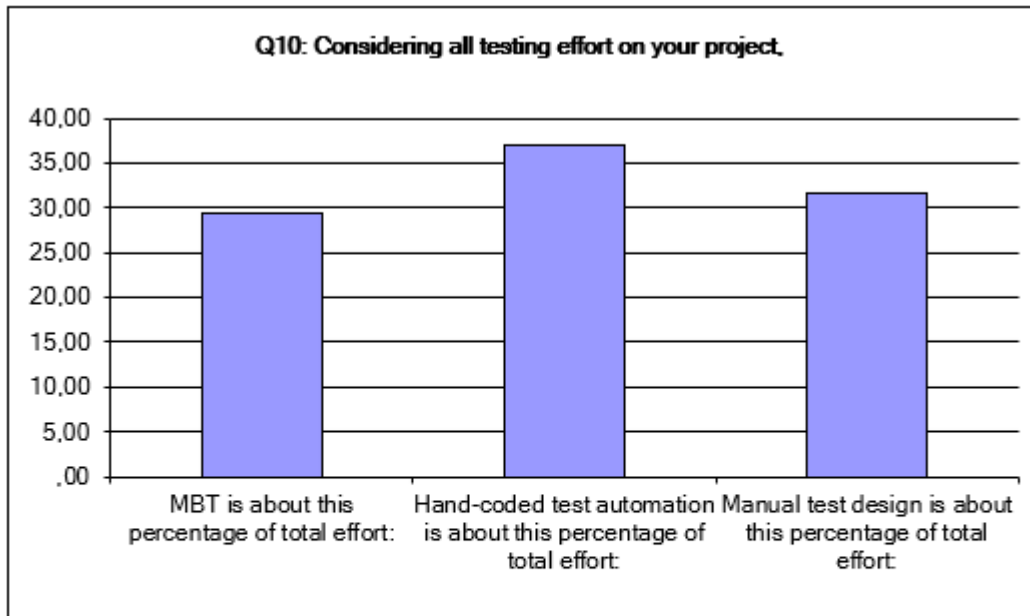
- Class diagrams
- My organization uses sequence diagrams extensively in designing the software. State machines are used for some software that has complex behavior.
- decision tables

Question 9: Degree of reuse (15 answers)



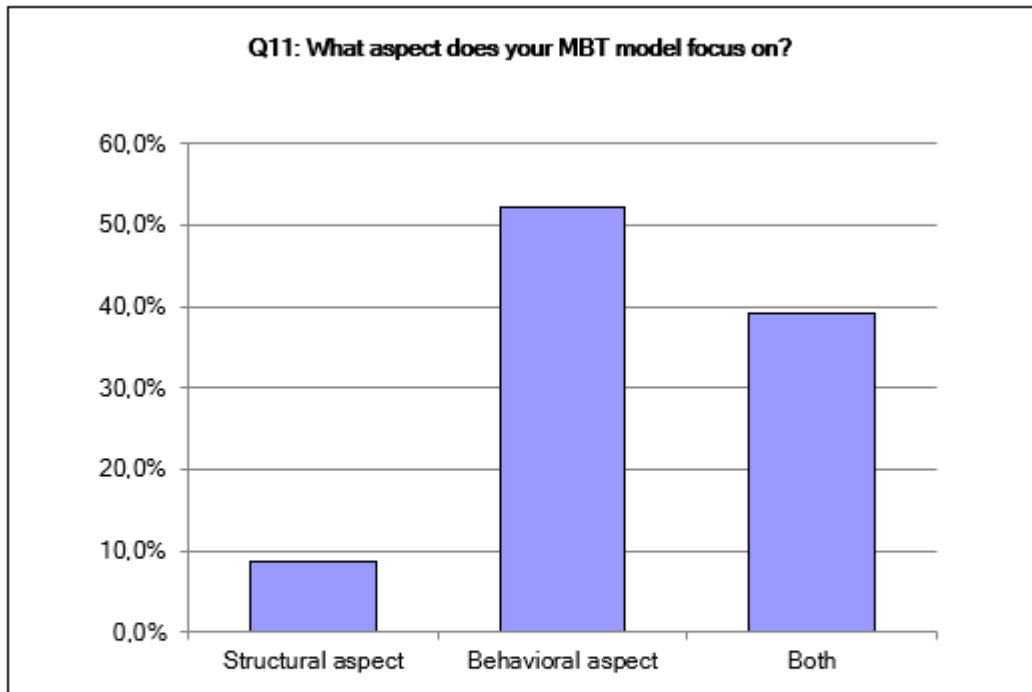
Degree of reuse	2019	2016	2014
Completely identical	13%	10%	15%
Slightly modified	20%	33%	29%
Largely modified	47%	30%	33%
Completely different	20%	27%	23%

Question 10: Testing effort (23 answer)



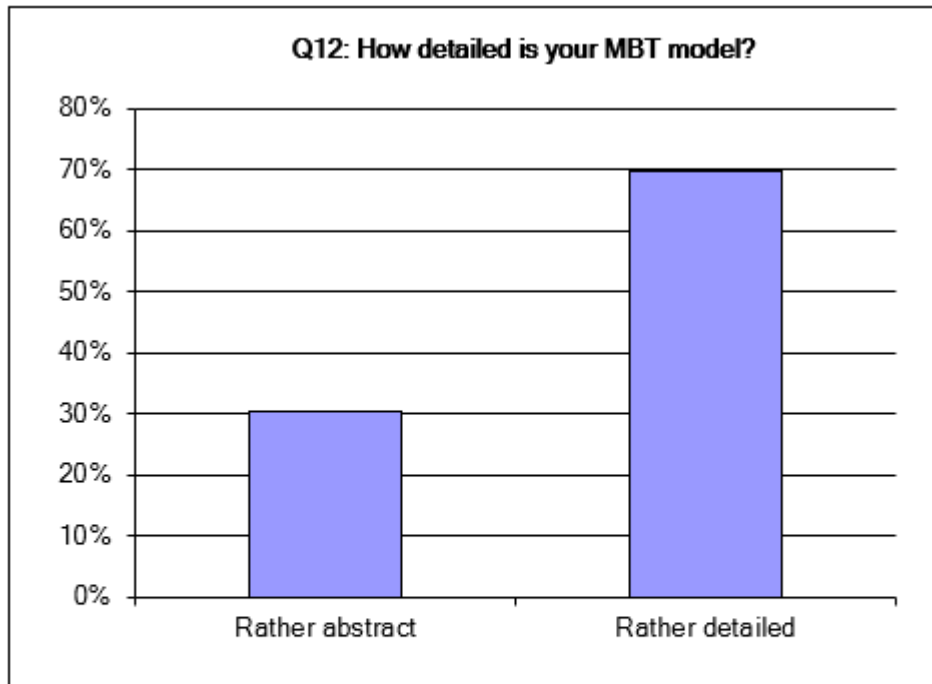
Answer Options	2019	2016	2014
MBT is about this percentage of total effort:	29,48	29,77	28,95
Hand-coded test automation is about this percentage	37,05	32,74	34,62
Manual test design is about this percentage of total	31,57	36,32	36,89

Question 11: MBT model focus (23 answers)



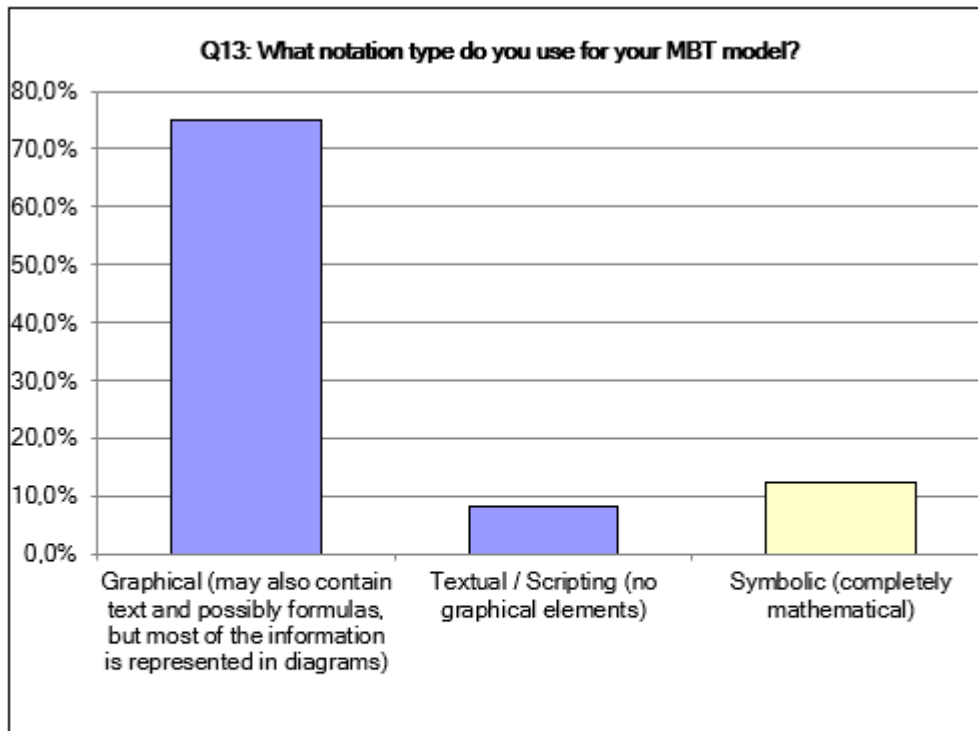
Answer Options	2019	2016	2014
Structural aspect	8,7%	7,7%	6,3%
Behavioral aspect	52,2%	69,2%	58,8%
Both	39,1%	23,1%	35,0%

Question 12: Degree of detail in MBT model (23 answers)



Degree of abstraction	2019	2016	2014
Rather abstract	30%	52%	43%
Rather detailed	70%	48%	57%

Question 13: Notation type (24 answers)

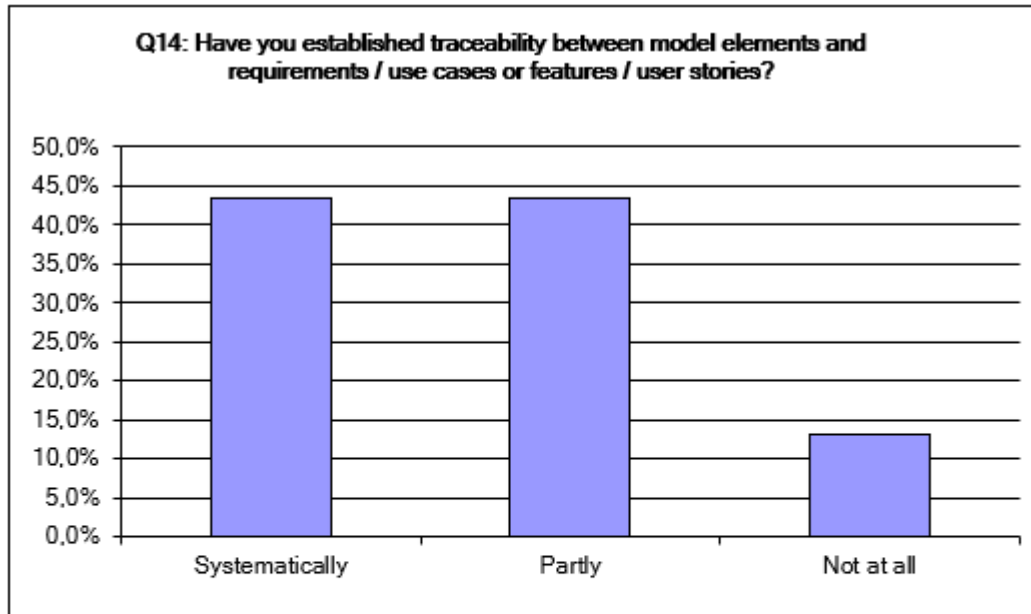


Answer Options	2019	2016	2014
Graphical	75,0%	75,5%	81,0%
Textual / Scripting	8,3%	24,5%	13,9%
Symbolic	12,5%	0,0%	5,1%

Other answers:

- both symbolic and graphical

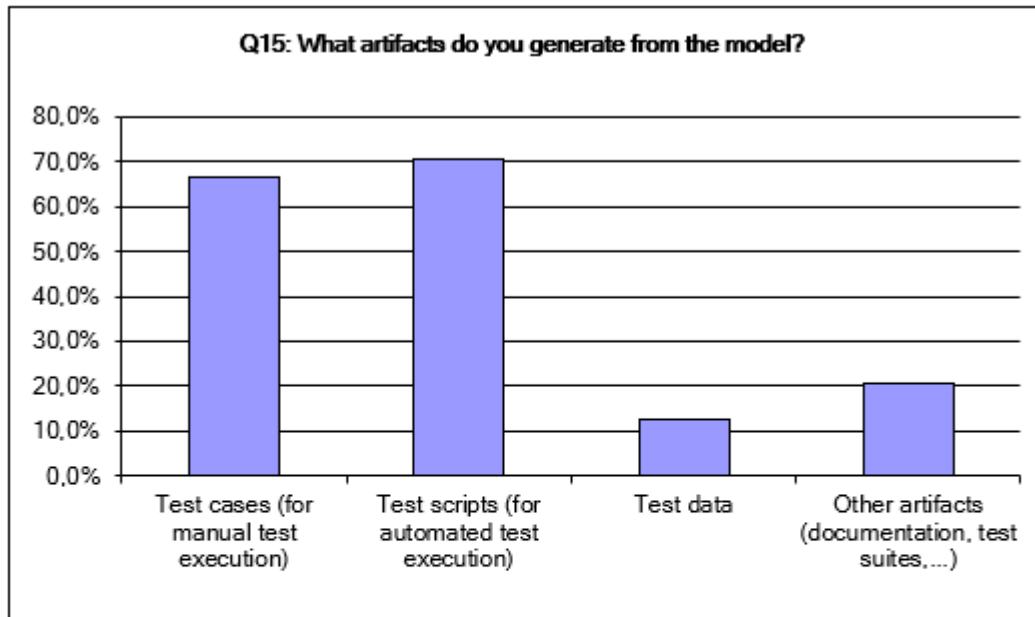
Question 14: Traceability (23 answers)



Answer Options	2019	2016 *)
Systematically	43,5%	34,6%
Partly	43,5%	46,2%
Not at all	13,0%	21,2%

*) Question asked for the first time

Question 15: Generated artifacts (24 answers)



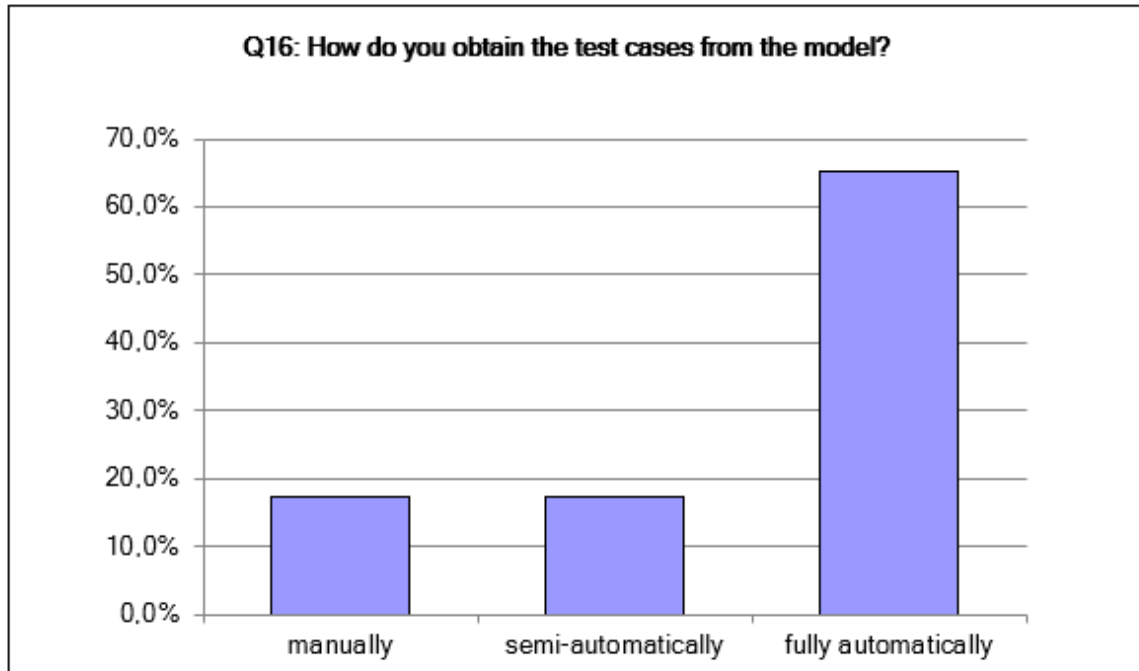
Answer Options

	2019	2016	2014
Test cases (for manual test execution)	66,7%	56,0%	56,6%
Test scripts (for automated test execution)	70,8%	80,0%	84,2%
Test data	12,5%	30,0%	39,5%
Other artifacts (documentation, test suites,...)	20,8%	28,0%	28,9%

Other answers:

(none)

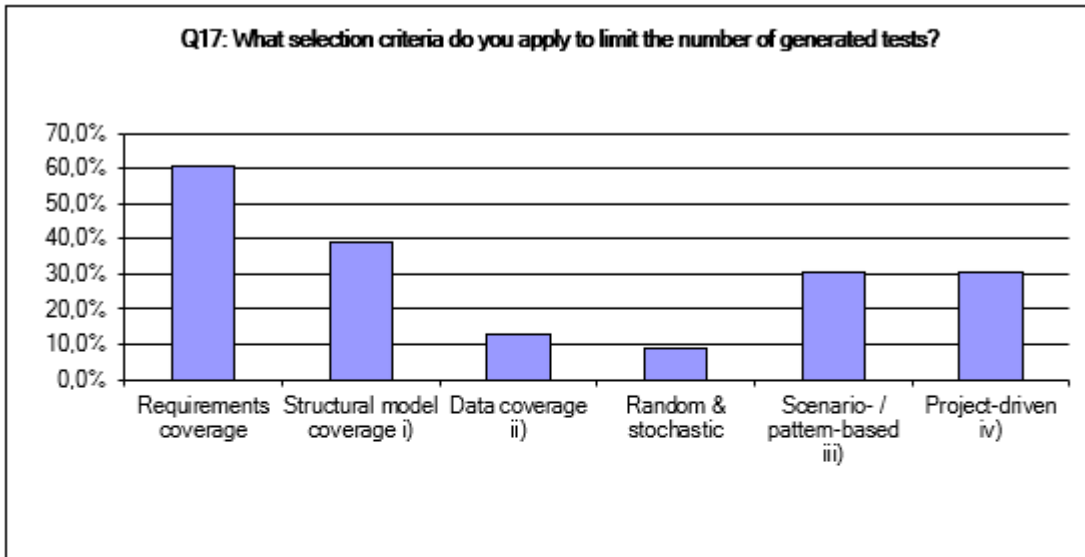
Question 16: Test case generation (23 answers)



Answer Options	2019	2016	2014
manually	17,4%	14,0%	11,8%
semi-automatically	17,4%	34,0%	35,5%
fully automatically	65,2%	52,0%	52,6%

This question aimed at the test artifact generation process. For tool integration, see question 19.

Question 17: Selection criteria (23 answers)



Answer Options

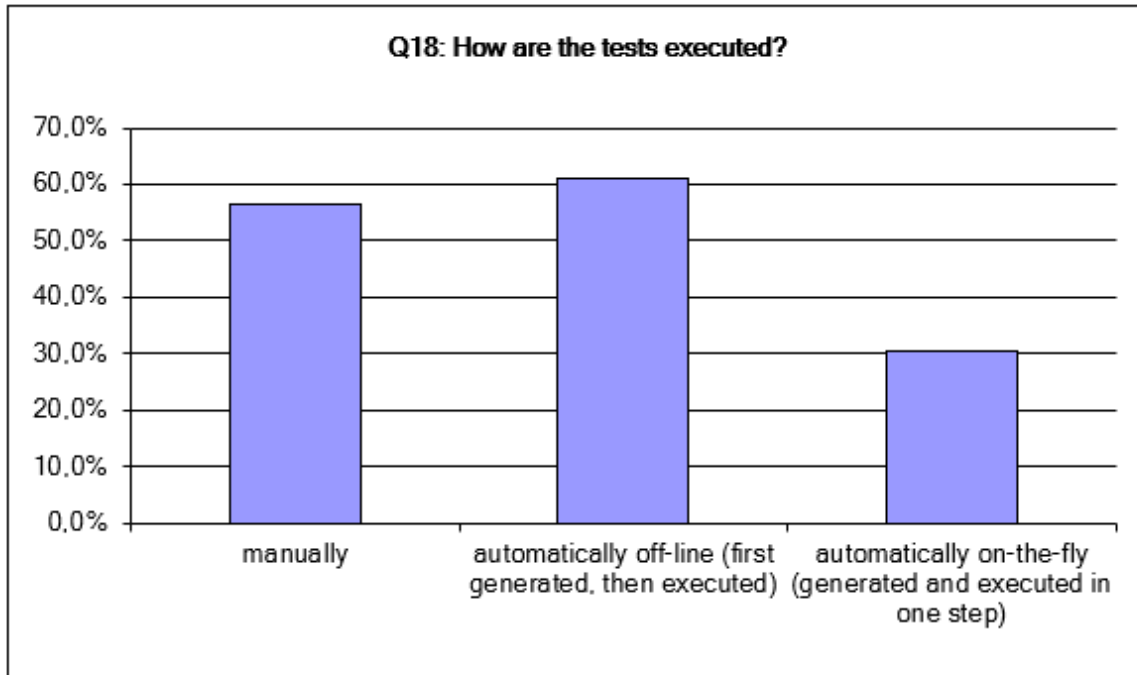
	2019	2016	2014
Requirements coverage	60,9%	60,0%	69,3%
Structural model coverage i)	39,1%	60,0%	58,7%
Data coverage ii)	13,0%	32,0%	28,0%
Random & stochastic	8,7%	24,0%	29,3%
Scenario- / pattern-based iii)	30,4%	32,0%	49,3%
Project-driven iv)	30,4%	18,0%	25,3%

Other answers:

(none)

- i) Structural model coverage is a generic term for a variety of coverage criteria that are based on the internal structure of the model (e.g. transition coverage).
- ii) Data coverage focuses on the equivalence partitions of input and output data, possibly combined with a boundary value analysis.
- iii) Scenarios or patterns are specific paths through the model that correspond to frequently used functionality or fault-based scenarios.
- iv) Project-driven test case selection criteria uses specific additional information added to the model (e.g. risk, priorities...) to drive test generation to achieve specific test objectives for the project.

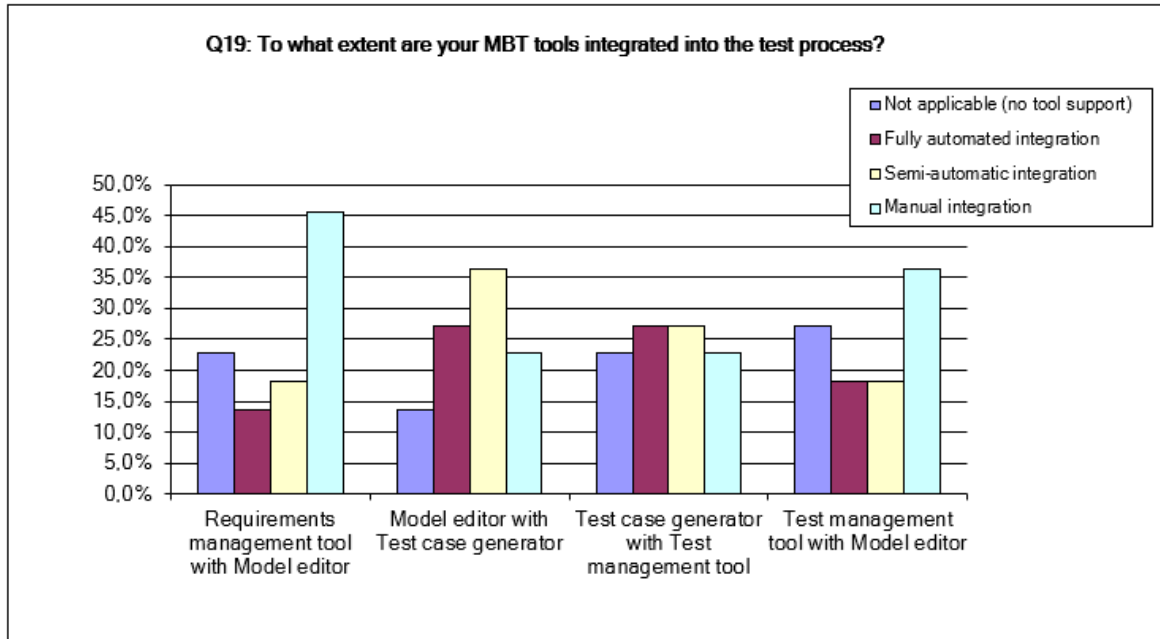
Question 18: Test execution (23 answers)



Answer Options

	2019	2016	2014
manually	56,5%	30,6%	34,7%
automatically off-line (first generated, then executed)	60,9%	57,1%	69,3%
automatically on-the-fly (generated and executed in one step)	30,4%	30,6%	24,0%

Question 19: Tools integration (22 answers)

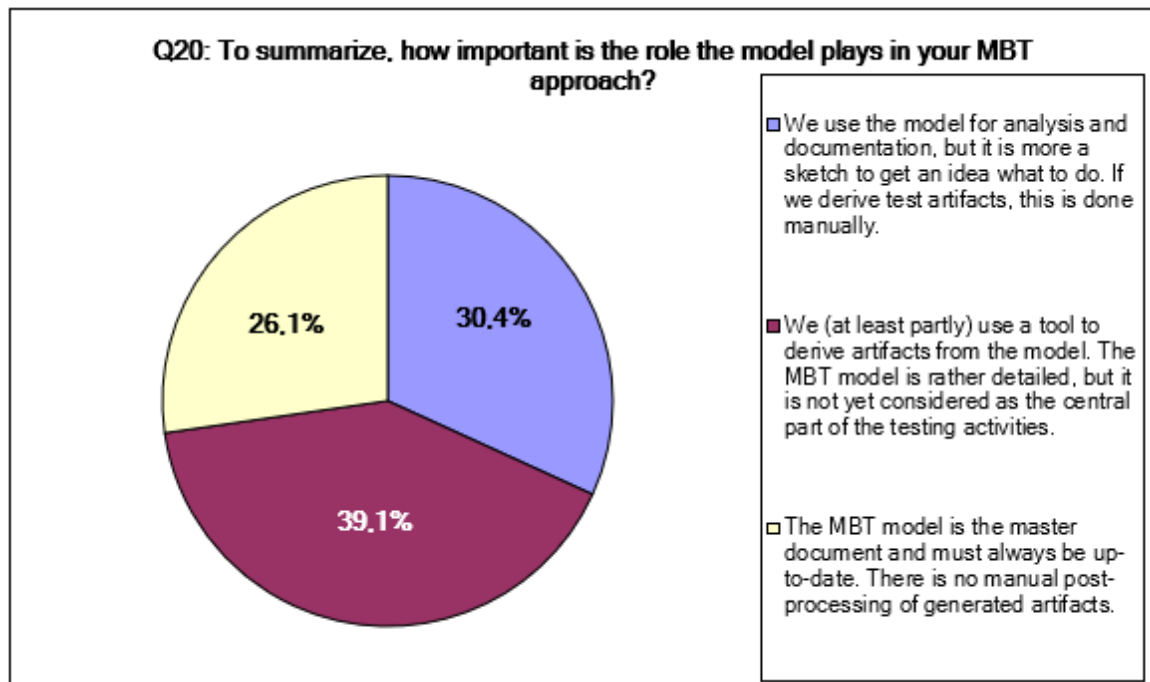


2019	Answer Options	Manual integration	Semi-automatic integration	Fully automated integration	Not applicable (no tool support)
	Requirements management tool with Model editor	45,5%	18,2%	13,6%	22,7%
	Model editor with Test case generator	22,7%	36,4%	27,3%	13,6%
	Test case generator with Test management tool	22,7%	27,3%	27,3%	22,7%
	Test management tool with Model editor	36,4%	18,2%	18,2%	27,3%

2016	Answer Options	Manual integration	Semi-automatic integration	Fully automated integration	Not applicable (no tool support)
	Requirements management tool with Model editor	31,1%	22,2%	13,3%	33,3%
	Model editor with Test case generator	11,1%	22,2%	51,1%	15,6%
	Test case generator with Test management tool	27,3%	25,0%	27,3%	20,5%
	Test management tool with Model editor	16,7%	31,0%	14,3%	38,1%

2014	Answer Options	Manual integration	Semi-automatic integration	Fully automated integration	Not applicable (no tool support)
	Requirements management tool with Model editor	31,9%	24,6%	13,0%	30,4%
	Model editor with Test case generator	18,6%	22,9%	41,4%	17,1%
	Test case generator with Test management tool	21,4%	30,0%	18,6%	30,0%
	Test management tool with Model editor	21,7%	15,9%	14,5%	47,8%

Question 20: Role the model plays in MBT approach (23 answers)



Answer Options

	2019	2016	2014
We use the model for analysis and documentation...	30,4%	15,2%	15,2%
We (at least partly) use a tool to derive artifacts from the model.	39,1%	52,2%	47,0%
The MBT model is the master document...	26,1%	32,6%	37,9%

Other answers:

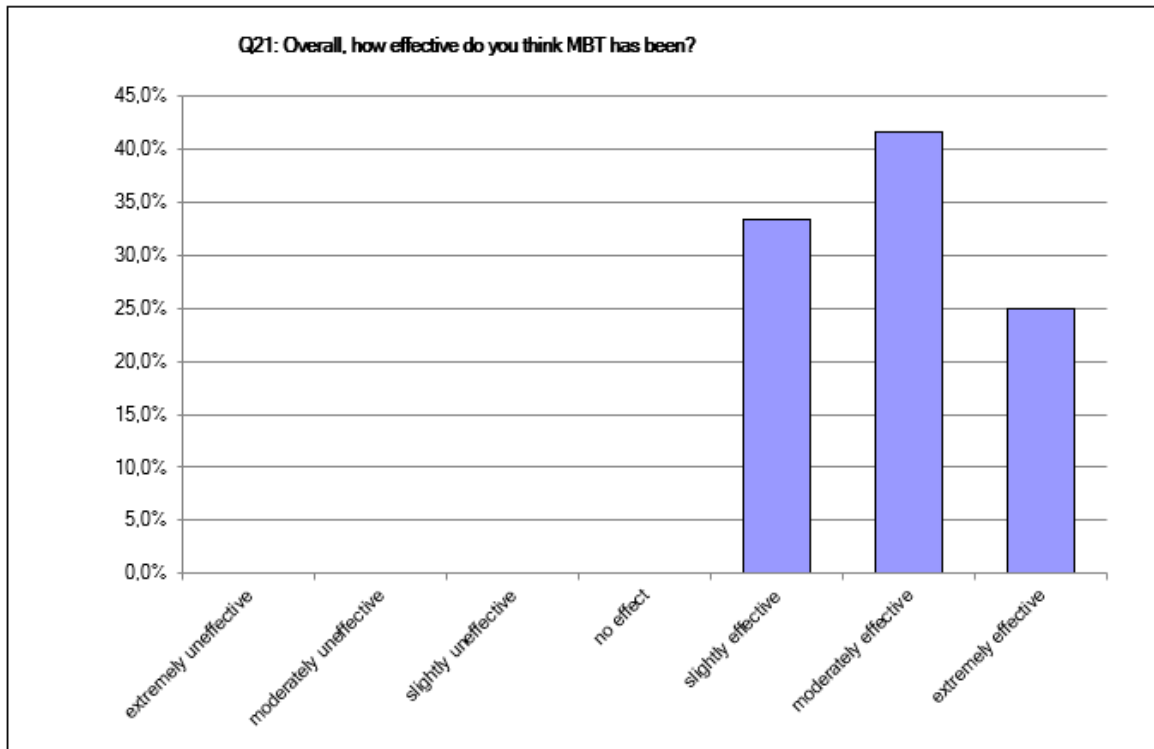
- inbetween 2 and 3

- My current organization is in the evaluation phase of MBT adoption. However the process I have proposed has the model as the source of truth for the testing. My recommendation is that generated test cases not be edited.

- MBT was very big for a while at <name of company>. But, we abandoned it in favor for massive numbers of short running tests that fit the CI process. Mostly unit and integration tests.

And, all tests are written by the developers, where additional, 'hard to understand' tools and methodologies like MBT, does create friction, and thus is discarded.

Question 21: How effective do you think MBT has been? (24 answers)



Answer Options

extremely ineffective
moderately ineffective
slightly ineffective
no effect
slightly effective
moderately effective
extremely effective

2019

0,0%
0,0%
0,0%
0,0%
33,3%
41,7%
25,0%

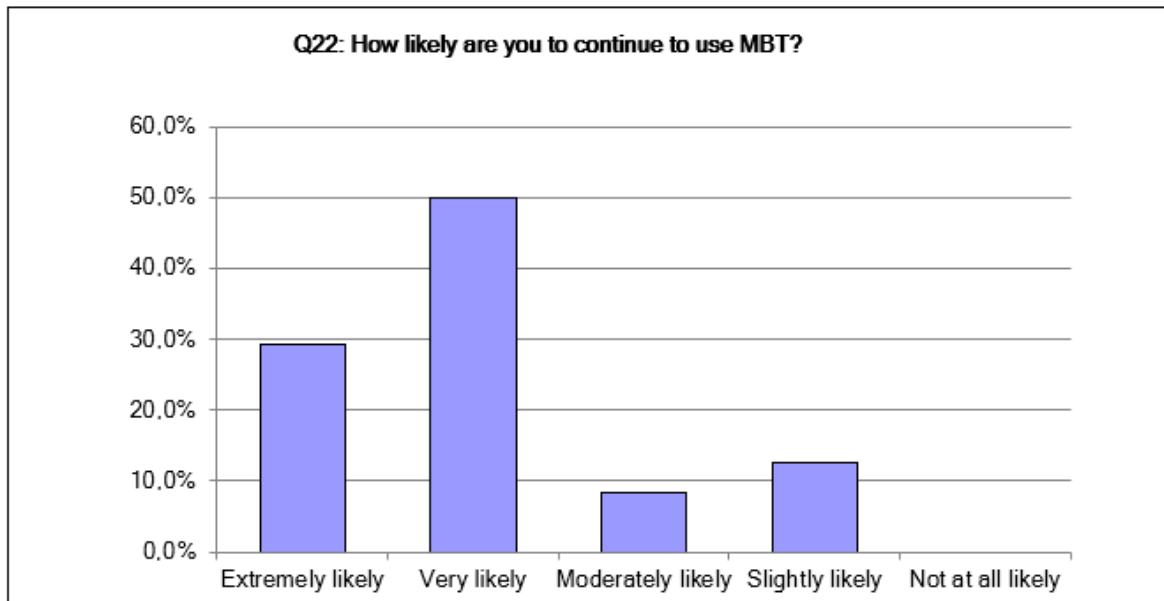
2016

4,5%
4,5%
2,3%
0,0%
27,3%
40,9%
20,5%

2014

2,8%
2,8%
1,4%
5,6%
23,6%
40,3%
23,6%

Question 22: How likely are you to continue to use MBT? (24 answers)



Answer Options

	2019	2016	2014
Extremely likely	29,2%	34,1%	35,6%
Very likely	50,0%	40,9%	37,0%
Moderately likely	8,3%	13,6%	21,9%
Slightly likely	12,5%	6,8%	4,1%
Not at all likely	0,0%	4,5%	1,4%

Question 23: Biggest limitation of MBT (17 answers)

**Q23: I see the biggest limitation of MBT as
(regarding the approach itself and/or its introduction and use):**

Answers:

- Takes time to implement effectively...
- The biggest limitation is that I need to create and maintain separate models specifically for MBT. I have not been able to find a model type that would be suitable both for MBT and communication with stakeholders.
- The learning curve of MBT makes it hard to introduce to organizations that are using hard coded automation methodologies such as BDD. MBT proponents need to emphasize building from existing hard coded automation and transitioning to MBT gradually.
- Adoption of MBT is getting impacted by the mindset of testers still relying on
- Tool support
- Resources are hard to find
- educating developers and mgmt
- A seamless integration of the development process for a developer. In my experience, the methodology and tool chain for MBT, causes too much friction for the everyday dev.
This is important, in an organization, where the devs are responsible to write all automated verification. Like unit- integration and system level tests.
- Testmanagement and MBT often not matching because of different suppliers
- Construction and understanding of a model can be difficult for certain persons.
(answer translated to English)
- changing the mindset
- requirement coverage / test management tool
- The biggest obstacle to introduce MBT is to learn how to use the models to describe the test design
- Learning curve for test specialists is too steep
- Knowledge of Tester, infrastructure
- depending on many preconditions - automation only works with standards
- Acceptance amongst testers (supposed complexity) and management (introduction effort and priorities)

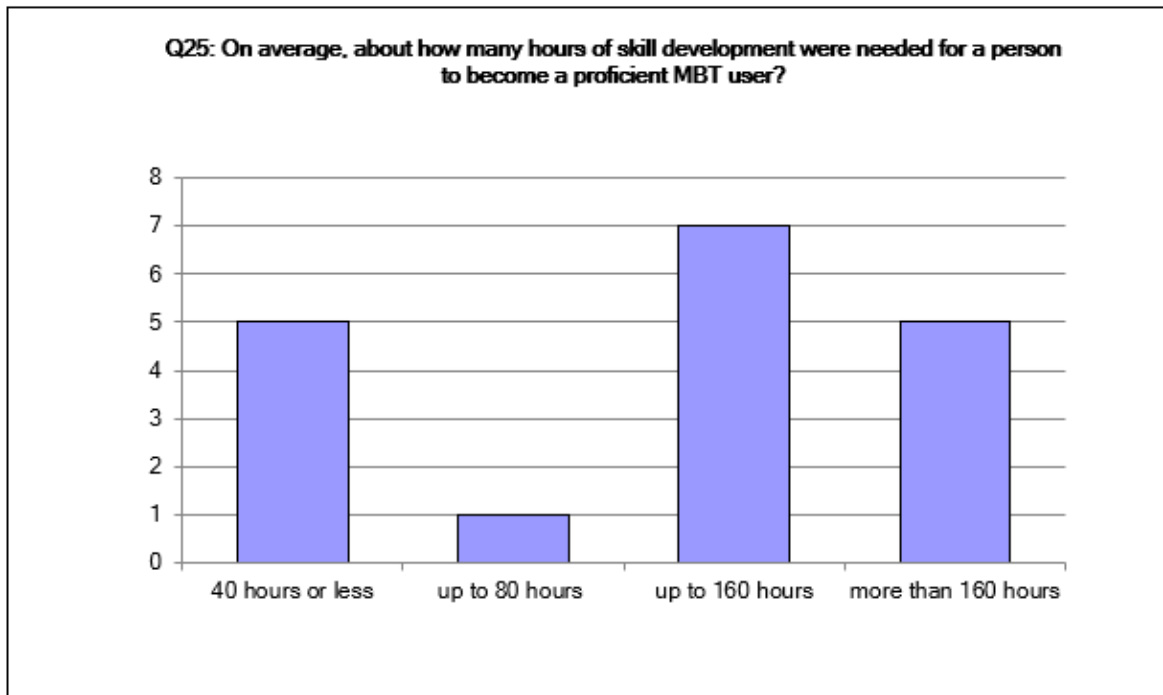
Question 24: Biggest advantage of MBT (18 answers)

Q24: I see the biggest advantage of MBT as:

Answers:

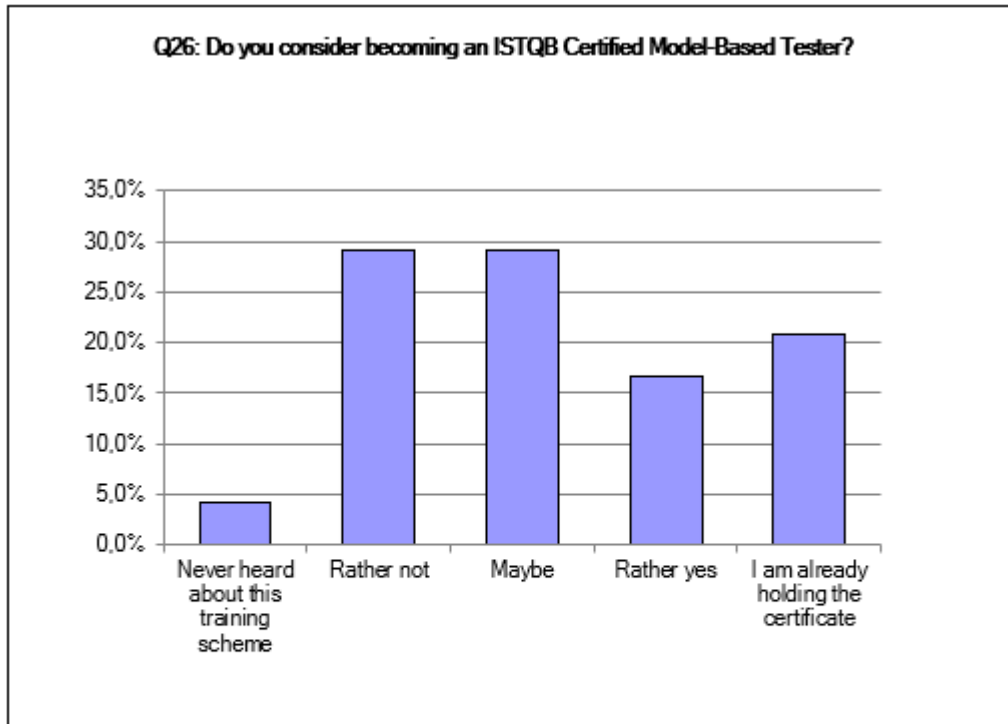
- Risk based test case design
- Providing very good test coverage of the system under test which in our case is very dependent on the equipment in runs on - i.e. enabling us to test the product in all its variations.
- Formal modelling process creates better tests that can find bugs difficult to find in any other way.
- Impact Analysis of Changes
- Test generation
- automated test design, and ability to regenerate test cases automatically when there is a change
- reduce maintenance, ease of use
- Too many to list. Better communication, reqmts tracing
- A clear separation of test design and the implementation.
- A tool to find bugs and the unexpected behaviors of a SUT.
- More effective test in less time
- Communication over the project
- Saves time when writing and maintaining test cases (*answer translated to*
- test maintenance and quality to automate it
- Coverage of an always updated test patrimony.
- Faster conception
- to understand the SUT and its complexity
- make the effort of test design independent from number of test cases (only if you create the TC from model)
- Communication
- efficiency gain & automated synchronization
- effectiveness and efficiency

Question 25: Hours needed to become a proficient MBT user (18 answers)



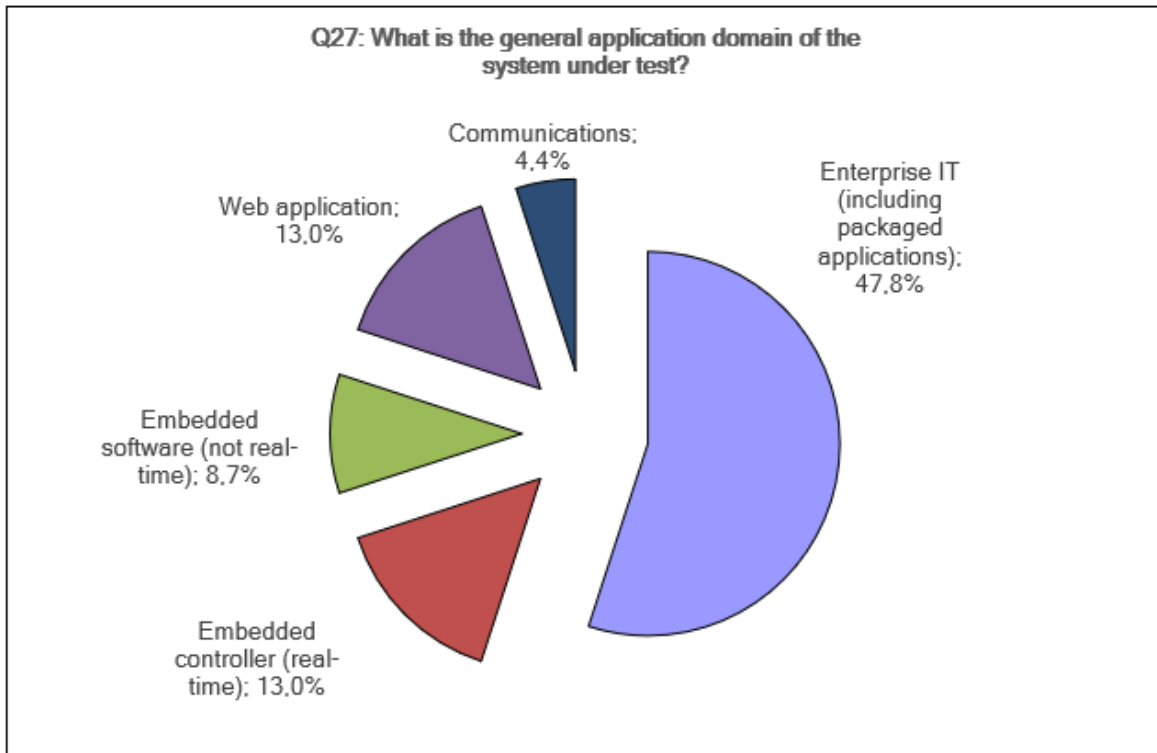
Average hours needed to become proficient	2019	2016	2014
Average	155	185	196
Median	120	100	80
Minimum value	16	8	0
Maximum value	500	700	2000

Question 26: ISTQB Certified Model-Based Tester (24 answers)



Answer Options	2019	2016 *)
Never heard about this training scheme	4,2%	13,6%
Rather not	29,2%	13,6%
Maybe	29,2%	38,6%
Rather yes	16,7%	29,5%
I am already holding the certificate	20,8%	4,5%

Question 27: General application domain of the system under test (23 answers)



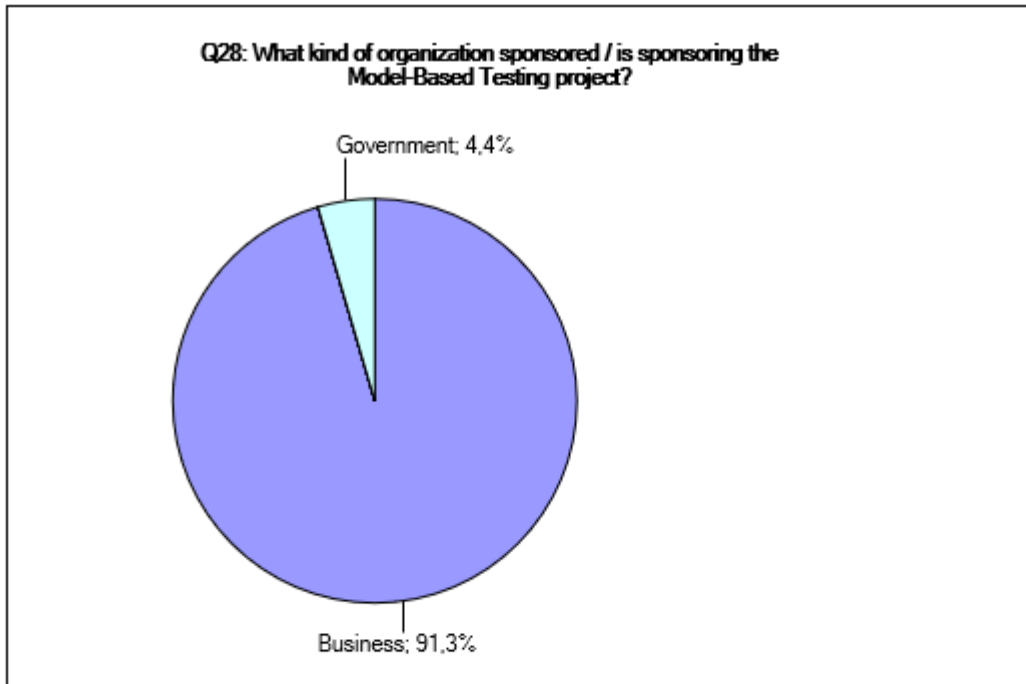
Answer Options

	2019	2016	2014
Enterprise IT (including packaged applications)	47.8%	30.0%	30.0%
Embedded controller (real-time)	13.0%	7.5%	27.1%
Embedded software (not real-time)	8.7%	10.0%	11.4%
Software Infrastructure	0.0%	10.0%	5.7%
Web application	13.0%	35.0%	18.6%
Gaming	0.0%	0.0%	2.9%
Communications	4.4%	7.5%	4.3%

Other answers:

- Medical software, where the available functionalities depend on measurement equipment it is connected to.
- telephone switching systems. This work was done in Italy 1978 to 1981
- All these

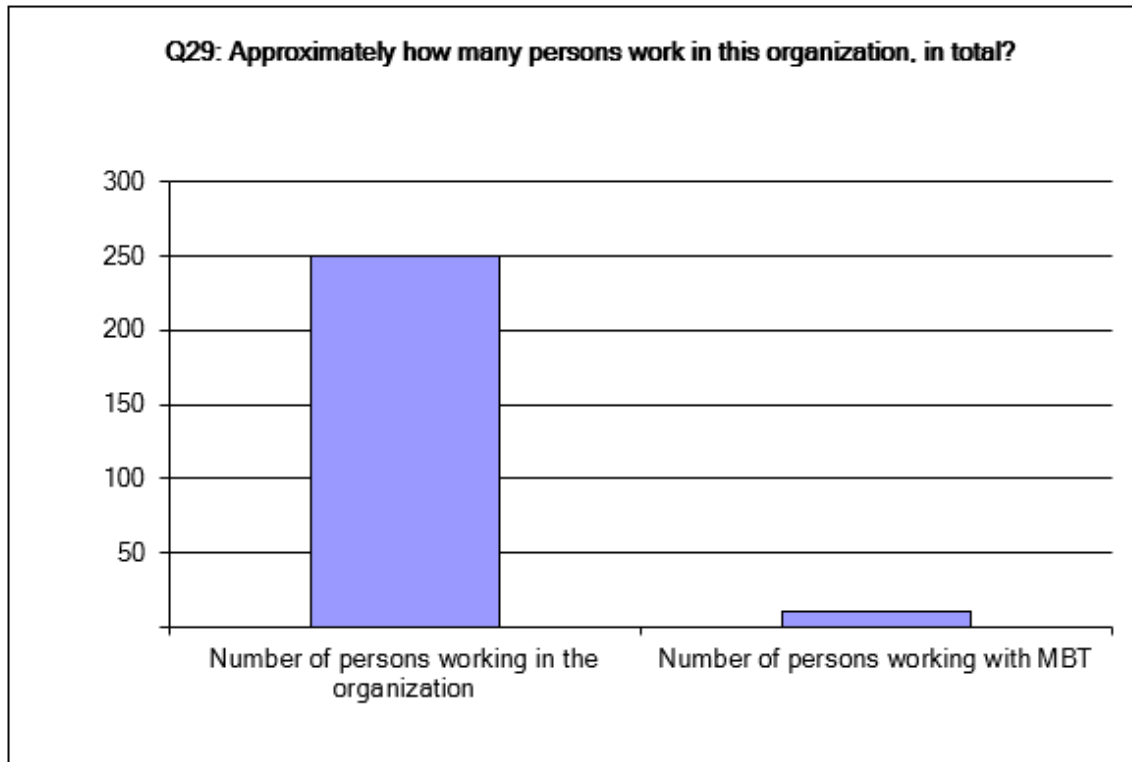
Question 258: MBT project sponsor (23 answers)



Answer Options

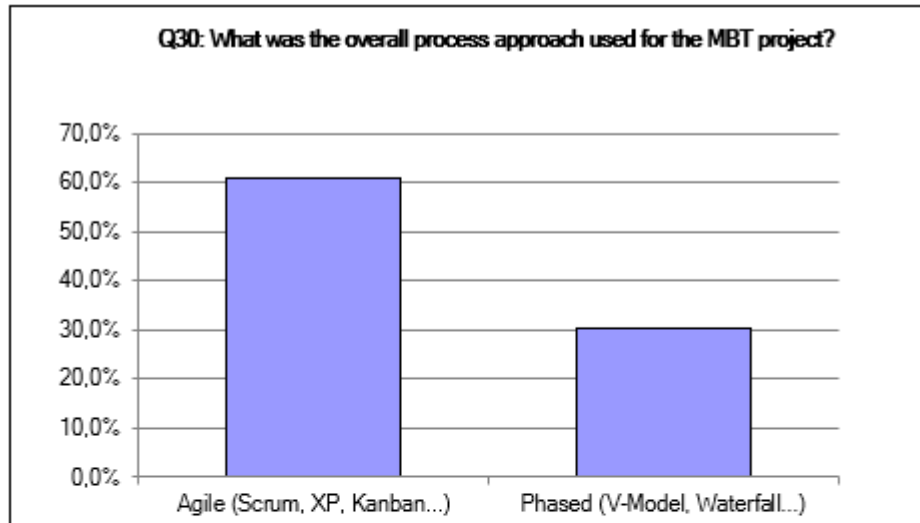
	2019	2016	2014
Business	91,3%	83,3%	86,2%
Educational / Research	0,0%	9,5%	9,2%
Non-profit	0,0%	2,4%	3,1%
Government	4,4%	4,8%	1,5%

Question 29: Size of organization (19 answers)



	2019	2016	2014
Number of persons working in the organization			
Average	9 405	27 010	12 236
Median	250	350	15
Minimum value	24	10	3
Maximum value	100 000	200 000	3 000 000
Number of persons working with MBT			
Average	24	120	325
Median	10	5	5
Minimum value	1	1	1
Maximum value	150	2 000	200

Question 260: Overall process approach (23 answers)



Answer Options

Agile (Scrum, XP, Kanban...)
Phased (V-Model, Waterfall...)

2019

60.9%
30.4%

2016

62.5%
37.5%

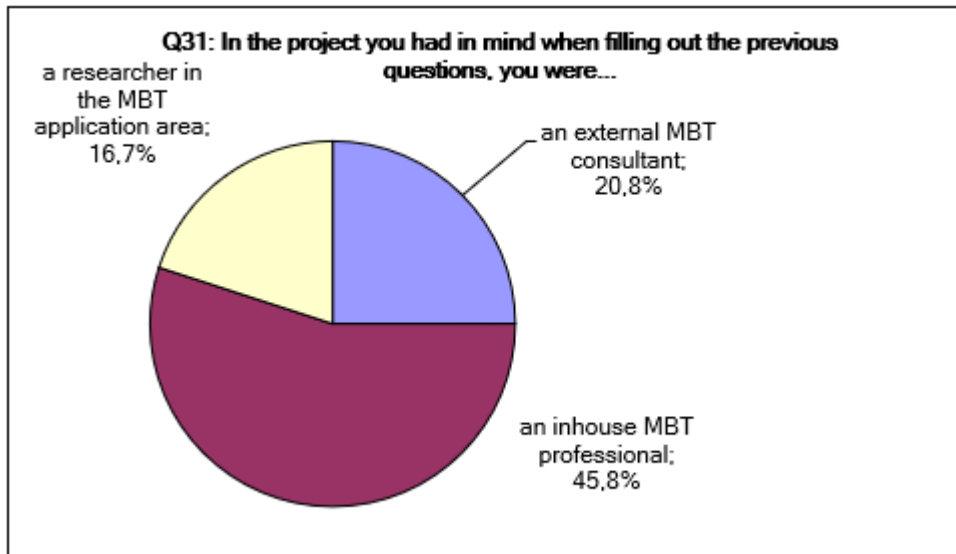
2014

44.4%
55.6%

Other answers:

- Varies...
- It's not an organized project, more of a voluntary initiative done in free time. The approach is pretty iterative, based on prototyping, evaluating and correcting.
- devSecops
- MBT is being used in projects following Sequential as well as Agile
- Both Agile and V cycle
- we use every approach depending of the project
- Does it matter?

Question 31: Role of respondents (24 answers)



Answer Options	2016	2016	2014
an external MBT consultant	20,8%	20,5%	17,9%
an inhouse MBT professional	45,8%	56,4%	59,7%
a researcher in the MBT application area	16,7%	23,1%	22,4%

Other answers:

- Mbt Enablement
- I'm actually a requirement engineer and ex-tester who wanted to promote models and
- I am a senior SDET who has used MBT before and am trying to introduce it to my
- in house governance
- responsible for full project testing
- we use MBT inhouse bit also as external MBT consultant