

Case Studies

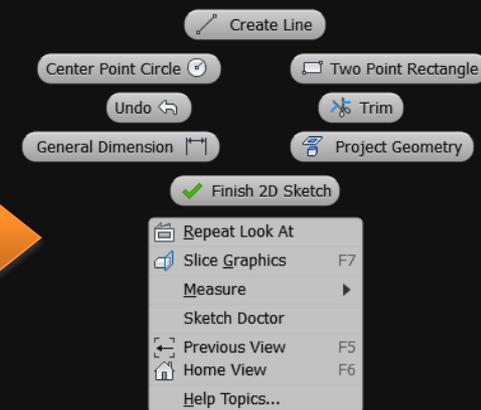
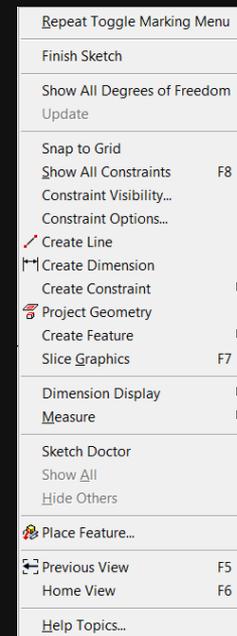
Data-driven design process in adoption of Marking Menus for large scale software

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Project Summary

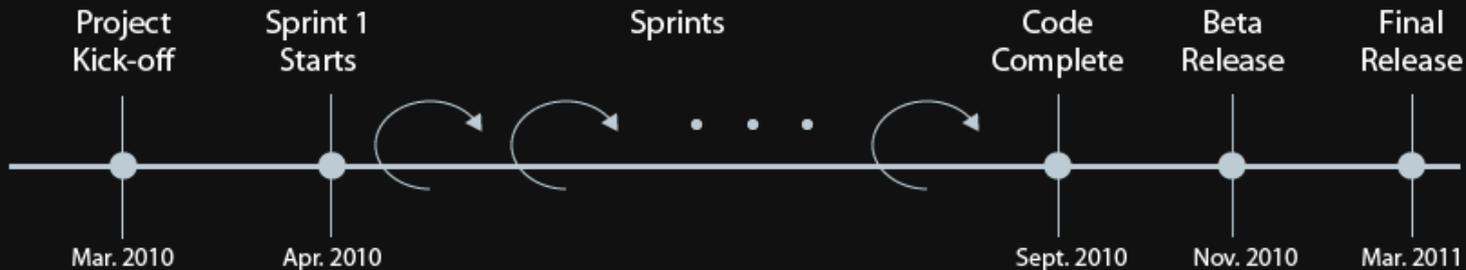
- **Purpose of the project**
 - Replace the linear context menu with marking menu in a large scale commercial software
- **Goals and Objectives**
 - Differentiate Autodesk brand from its competitors through the company's unique and innovative user interface
 - Improve user productivity via marking menu
- **Timeline**
 - Year 1 (FY 2010) adoption followed by the Year 2 (FY 2011) improvement



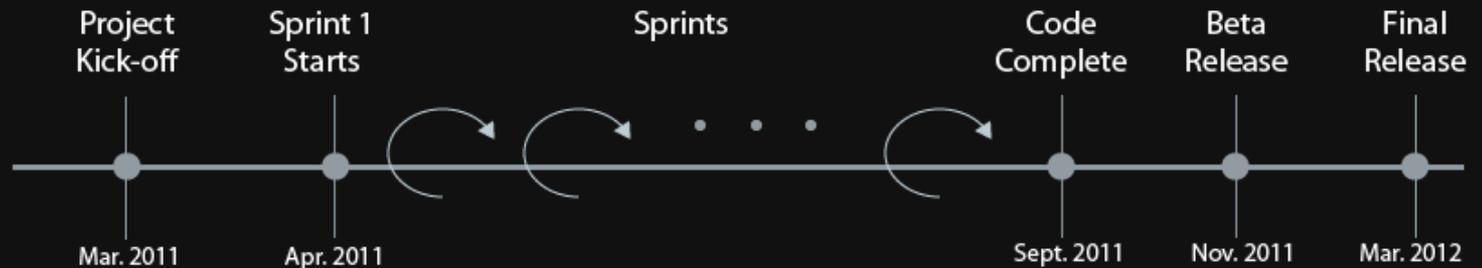


Project Timeline

Year 1: Initial adoption of marking menu



Year 2: Improvement based on user feedback





Stakeholders

- Several teams across the organization were stakeholders.
 - **Autodesk Research**: Original inventors of Marking Menus
 - **Platform Team**: Ensuring consistency of commands across products
 - **Product Team**: Ensuring design works for target users
- Product Management, Engineering and UX partnered on the product team.



Project Requirements

- **Business/Marketing/Scalability:** The new UI should be adopted by most of our users
- **Usability:** Streamlined access to frequently used commands
- **Consistency:** The gestures are consistent within and across products



HCI Best Practice Solution

- **Project Narrative:** This case study presents the iterative design process where user data and feedback played key role in successful adoption of the marking menu to the large scale CAD software.



Methods used and how

- **Analysis of instrumented usage data** to produce initial design
- **Iterative validation** using the working code throughout development process
- **Longitudinal study** to understand usage over time
- **Beta survey** to continued improvement



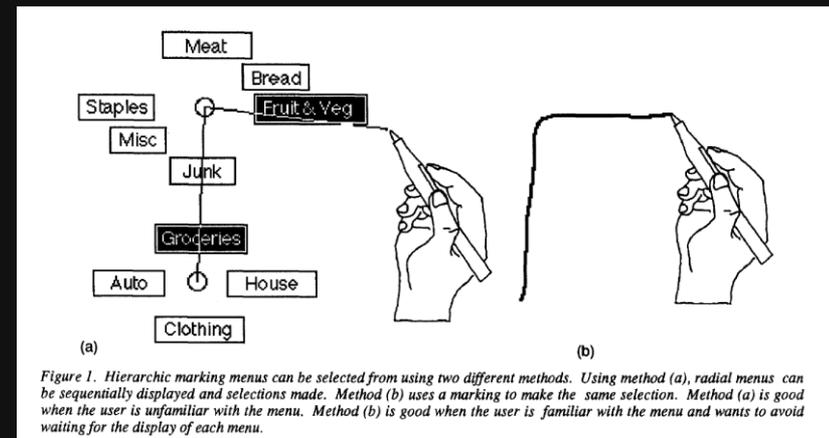
What is Marking Menu?

Marking Menu:

A marking menu is an interaction technique that allows a user to select from a menu of items using a radial section.

Gesture Mode:

A user makes a selection by drawing a mark. A user enters this mode by pressing the cursor and immediately moving in the direction of the desired menu item.



[Click here for Demo of Marking Menu vs. Linear Menu by Gord Kurtenbach](#)

Gord Kurtenbach & Bill Buxton. (1993). **The Limits of Expert Performance Using Hierarchic Marking Menus.** *CHI 1993 Conference Proceedings*, pp. 482-487

Gord Kurtenbach, George Fitzmaurice, Russel Owen & Thomas Baudel. (1999). **The Hotbox: efficient access to a large number of menu-items.** *CHI 1999 Conference Proceedings*. pp. 231-237.

Gord Kurtenbach & Bill Buxton. (1994). **User learning and performance with marking menus.** *CHI 1994 Conference Proceedings*, pp. 258-264.

Wendy E. Mackay, (2002) **Which interaction techniques works when? Floating palettes, marking menus and toolglasses support different task strategies.** *AVI 2002 Conference Proceedings*, pp. 203-208.



CHI Research to Mass Adoption

- Marking Menus was invented by Gord Kurtenbach and Bill Buxton in early 1990s and the CHI community is familiar with the research done by since its inception.
- Although the research has proved Marking Menus as an efficient design, only a few niche Autodesk products (Maya and Mudbox) integrated the interface over the years.
- In this case study, we will talk about user-centered design process that led to integrating Marking Menus into a core Autodesk product, Inventor.
- The success of Marking Menus in Inventor has led to integrating the UI in Autodesk flagship product, AutoCAD in Year 2.



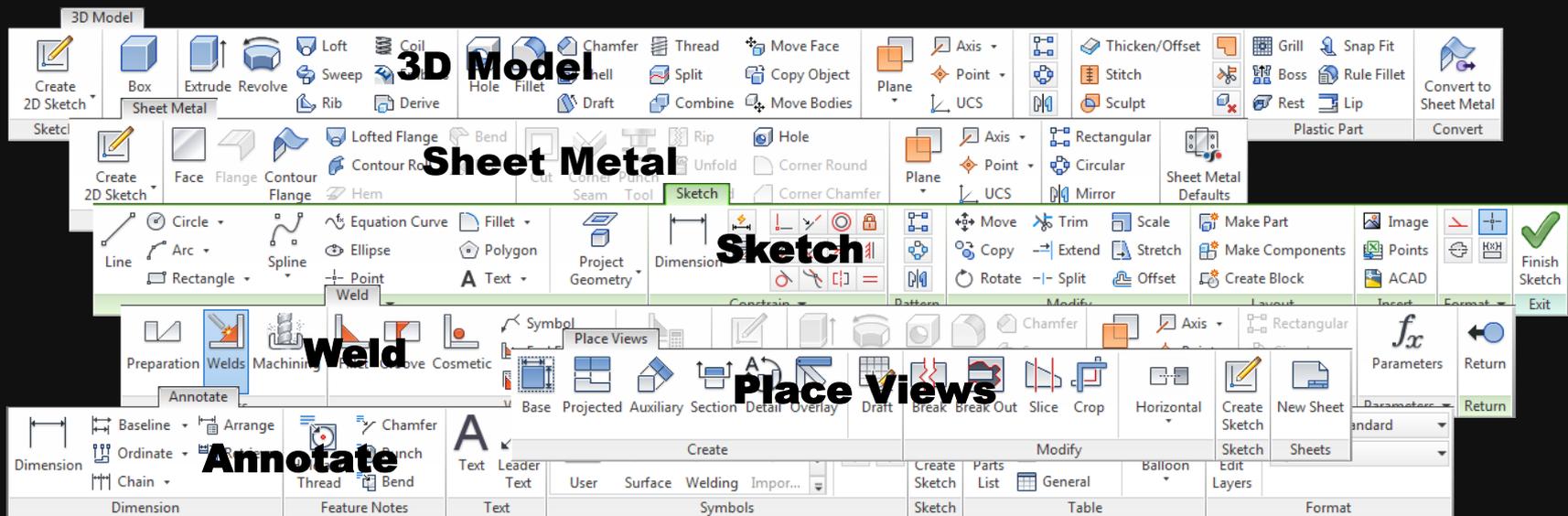
Challenges

- The size of the product
- Existing users learning a new interface



The size of the product

- Over **three thousand commands** including add-in commands
- Four document types
 - Part modeling, assembly, drawing, and presentation documents
- Over twenty task environments

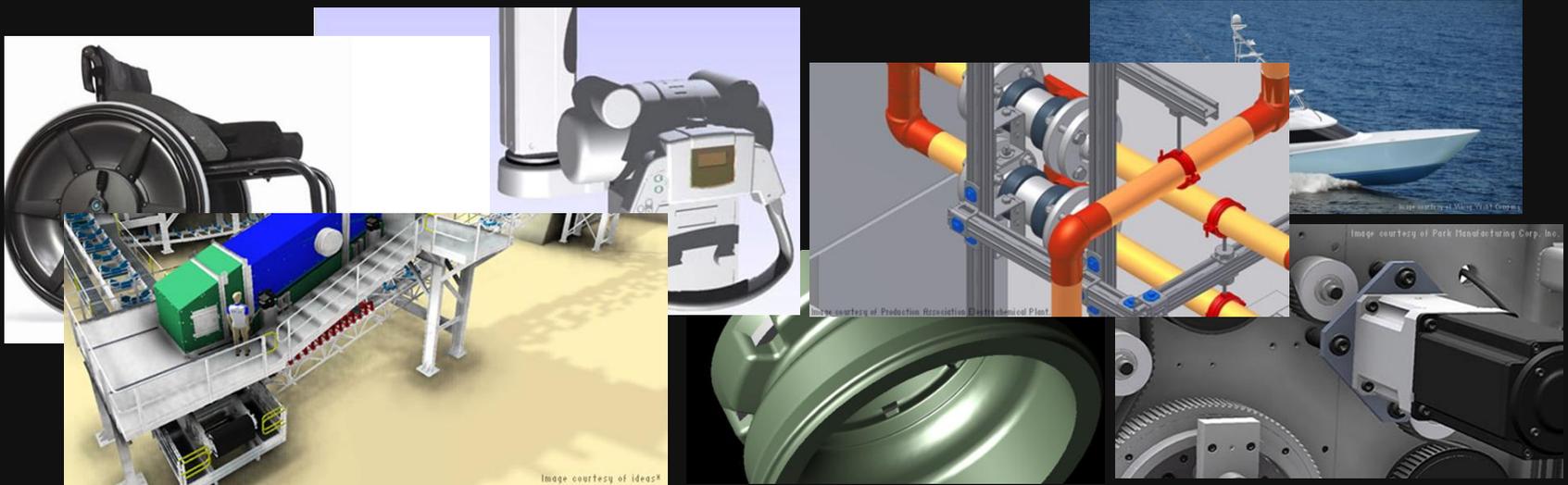


Sample toolbars in the product



The existing user base

- About 800,000 users' install base
- Application mainly on manufacturing industry, includes heavy machinery, consumer products, building products, automotive, medical equipment, and so on.
- Tasks are highly contextual, thus typical users heavily rely on right click menus to access contextual commands



Example products from the customers



Challenges

- How do we organize the marking menu to satisfy the large number of users?
- How do we redesign existing right-click menu for every scenario in the product?



How did your team address the challenge

- Start Simple, let it grow with users
- Data-driven design process
 - Usage data and user feedback is incorporated throughout the design and development process



Start simple, let it grow with users

- Start out with simple layout that covers high usage level per *task environment**
- Identify must-haves from users
- Understand design implications in frequent 1:1 usability studies and longitudinal studies
- Iterate on design based on feedback

*Autodesk Inventor is organized by set of task-based commands such as sketch, 3D modeling, assembly, simulation, etc. Users perform different types of tasks moving from one environment to next.



Data-driven Design Process

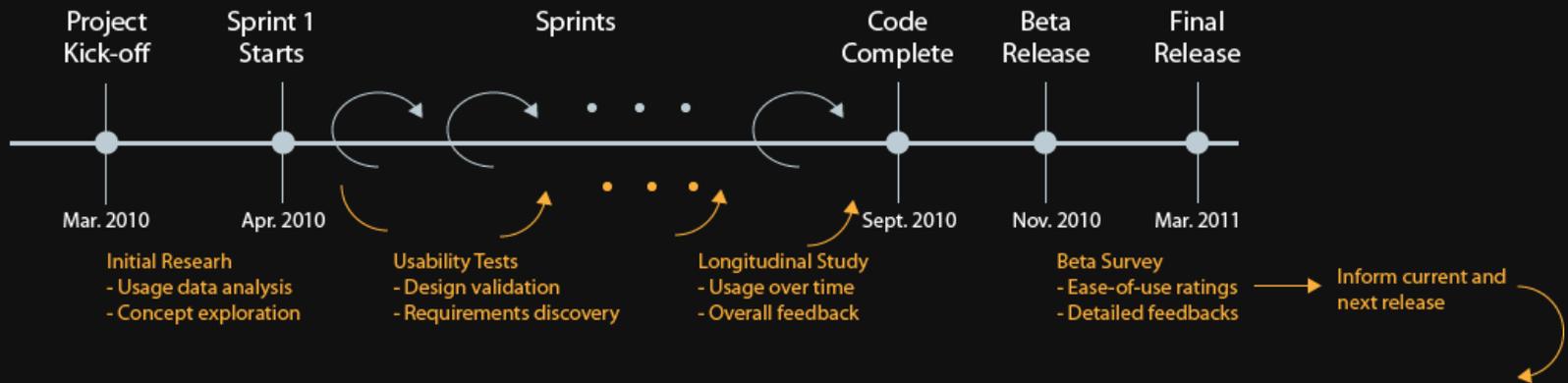
The design process involved the following steps:

1. Extensive usage data analysis
2. Concept generation based on data
3. User research to help iterate on designs
4. High-level workflow that represents improvements in the following release
5. In released product, instrument the marking menu itself to track usage in Year 1

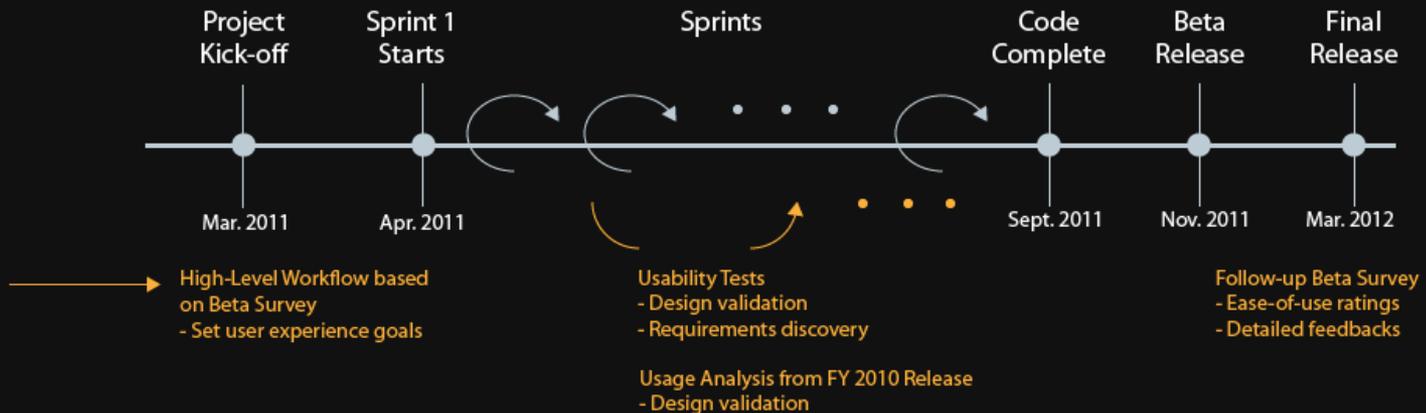


UX Activities in Project Timeline

Year 1: Initial adoption of marking menu

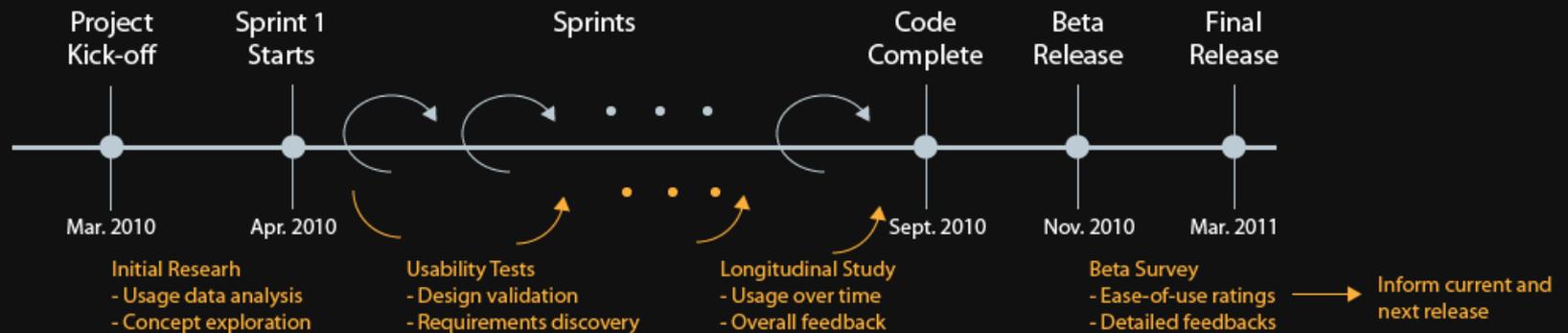


Year 2: Improvement based on user feedback





Year 1: Initial adoption of marking menu



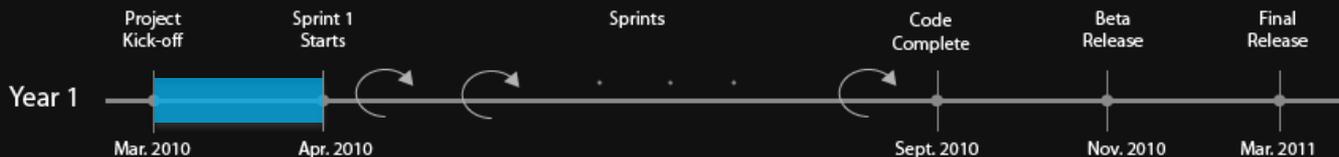


Usage Data Analysis: Data

- Data analysis goal
 - Identify high usage commands in Inventor
 - Measure the coverage of those commands in the user workflow
- Data collected
 - Total 17,405 opt-in users of Inventor 2010 between May, 2009 to Oct, 2009
 - Total command count per task environment (e.g. sketch, 3D modeling, etc.)

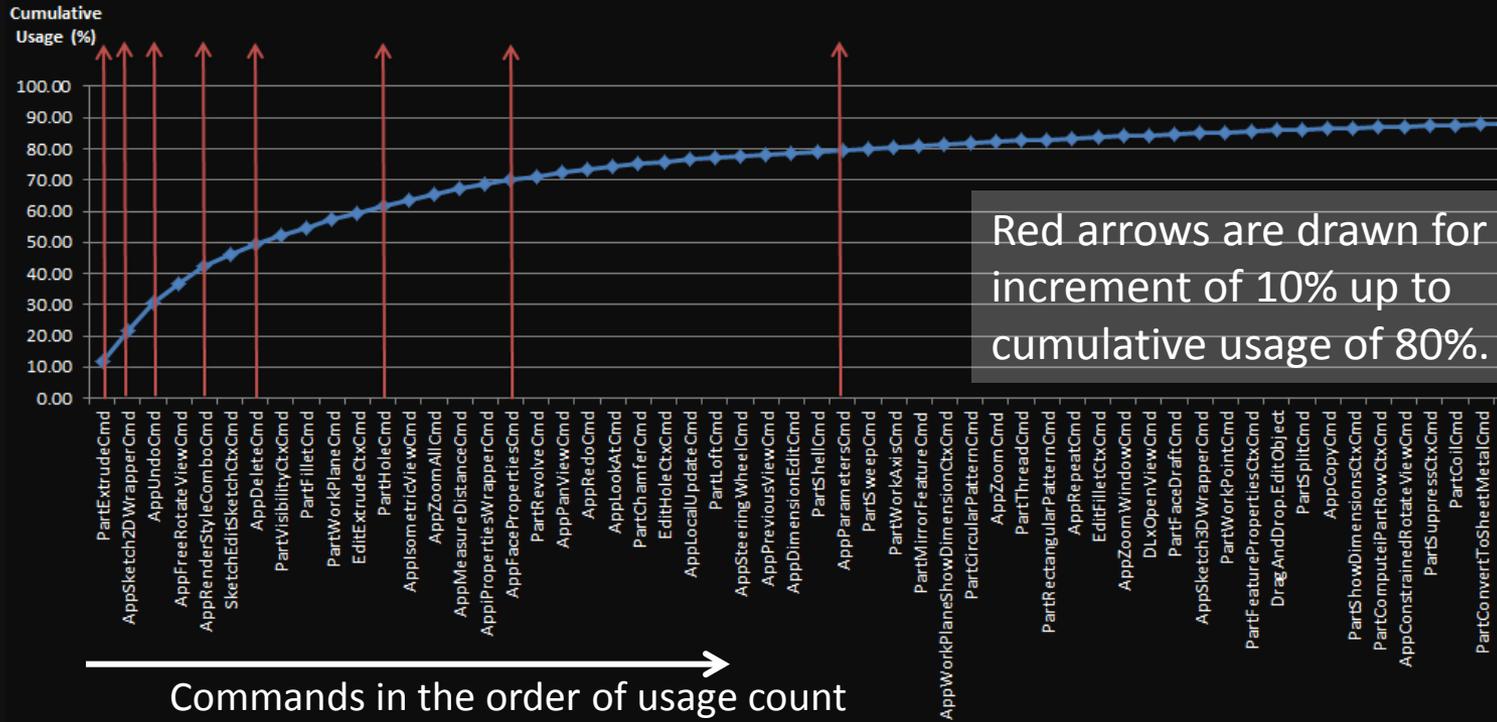
COMMAND_NAME	ENVIRONMENT_NAME	TOTAL_COUNT
Spaceball	PMxPartEnvironment	450,307
AppUndoCmd	PMxPartSketchEnvironment	379,047
GetPointDone	PMxPartSketchEnvironment	368,825
AppDimensionWrapperCmd	PMxPartSketchEnvironment	351,376
Spaceball	PMxPartEnvironment	319,785
SketchLineWrapperCmd	PMxPartSketchEnvironment	288,600
GetPointDone	PMxPartSketchEnvironment	255,796
AppDimensionWrapperCmd	PMxPartSketchEnvironment	211,590
AppRotateViewCmd	PMxPartEnvironment	206,922
PartNewSketchCmd	PMxPartSketchEnvironment	199,289
AppReturnPreviousCmd	PMxPartSketchEnvironment	198,116
Finish2dSketchCmd	PMxPartSketchEnvironment	190,832
Spaceball	PMxPartSketchEnvironment	181,280
BrowserVerticalScroll	PMxPartEnvironment	169,274
PartExtrudeCmd	PMxPartEnvironment	163,174
AppRotateViewCmd	PMxPartEnvironment	157,288
PartNewSketchCmd	PMxPartSketchEnvironment	148,471
AppUndoCmd	PMxPartSketchEnvironment	146,880
AppReturnPreviousCmd	PMxPartSketchEnvironment	146,481
Spaceball	MBxSheetMetalEnvironment	138,968
Finish2dSketchCmd	PMxPartSketchEnvironment	135,489
BrowserVerticalScroll	PMxPartEnvironment	134,146
AppSketch2DWrapperCmd	PMxPartEnvironment	132,413
SketchLineWrapperCmd	PMxPartSketchEnvironment	131,460
AppUndoCmd	PMxPartSketchEnvironment	129,790
AppDimensionWrapperCmd	PMxPartSketchEnvironment	128,206
SketchCenterPointCircleCmd	PMxPartSketchEnvironment	122,271
AppDimensionEditCmd	PMxPartSketchEnvironment	118,004
Spaceball	PMxPartSketchEnvironment	114,847
ExpandBrowserNode	PMxPartEnvironment	109,391
ExpandBrowserNode	PMxPartEnvironment	105,844
AppDeleteCmd	PMxPartSketchEnvironment	103,297
AppDimensionWrapperCmd	PMxPartSketchEnvironment	102,578
SketchTwoPointRectangleCmd	PMxPartSketchEnvironment	102,503
FinishSketch	PMxPartSketchEnvironment	101,220
AppFreeRotateViewCmd	PMxPartEnvironment	92,650
AppDimensionEditCmd	PMxPartSketchEnvironment	91,816
FinishSketch	PMxPartSketchEnvironment	91,502
AppUndoCmd	PMxPartEnvironment	91,346
AppFileSaveCmd	PMxPartEnvironment	88,434
AppRenderStyleComboCmd	PMxPartEnvironment	84,075
AppFileSaveCmd	PMxPartEnvironment	81,264
AppLookAtCmd	PMxPartSketchEnvironment	77,677
AppFreeRotateViewCmd	PMxPartEnvironment	65,418
SketchEditSketchCxCmd	PMxPartEnvironment	63,598
AppFileOpenCmd	PMxPartEnvironment	61,334
PartExtrudeCmd	PMxPartEnvironment	60,323
AppLookAtCmd	PMxPartSketchEnvironment	59,003
Spaceball	MBxSheetMetalEnvironment	58,576
AppSketch2DWrapperCmd	PMxPartEnvironment	56,135
SketchEditSketchCxCmd	PMxPartEnvironment	55,074

Sample Data



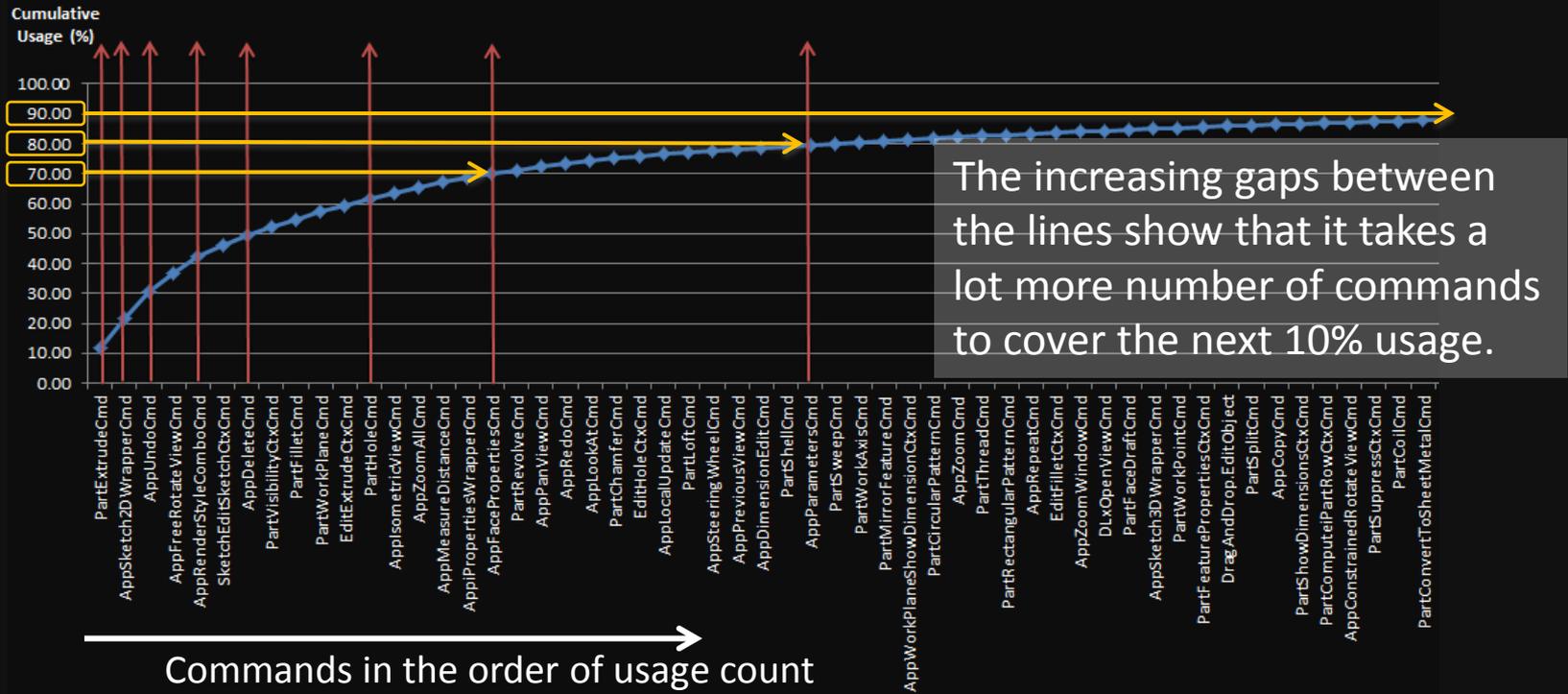


Usage Data Analysis: Result

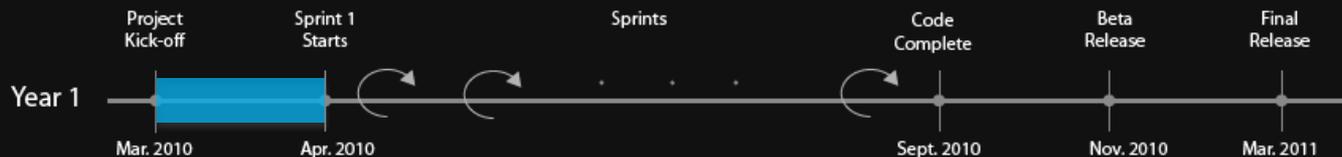




Usage Data Analysis: Result



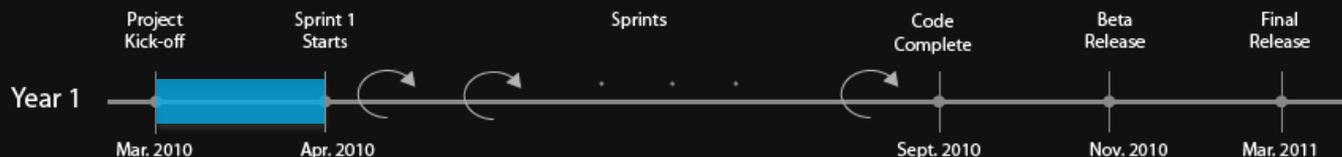
- About top **20-30 commands** per work environment take up **80% of usage**.
(The example above shows 30 commands out of 1,112 commands take up 80% of usage)





Usage Data Analysis: Insights

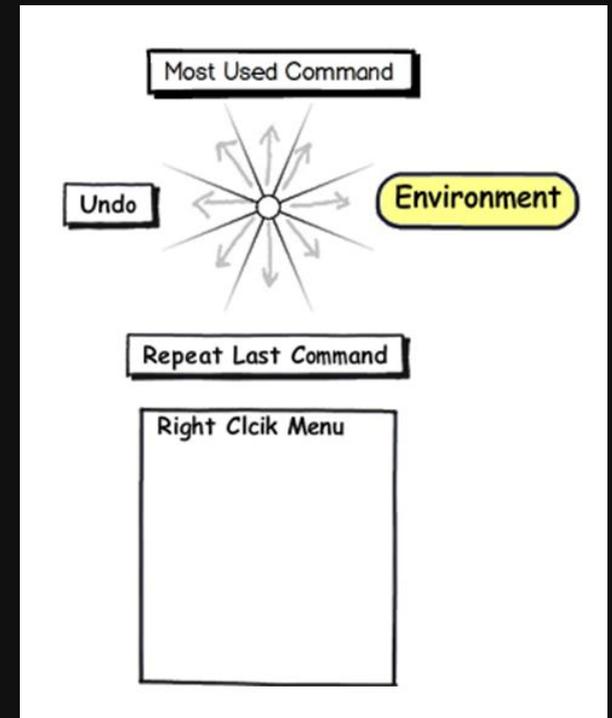
- **Results support single level menu approach**
 - Two-level menus can only increase the usage coverage by 3-5% over the single-level menus.
- **Build a frame that is consistent all across the software**
 - Undo and task environment navigation commands (e.g. switch from sketch to part, etc.) are commonly used across entire software.
 - There is a unique command to each environment that is very highly used (e.g. line command in sketch, extrude command in 3D modeling, etc.)





Design Concepts: Frame Consistency

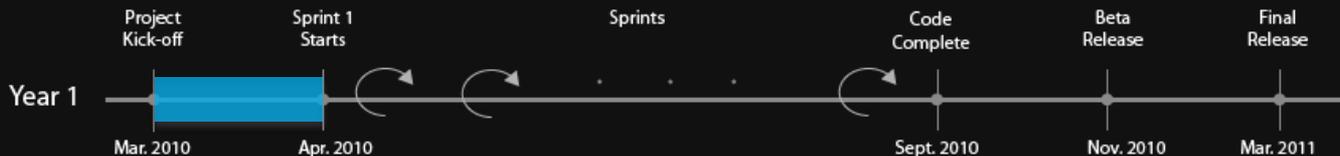
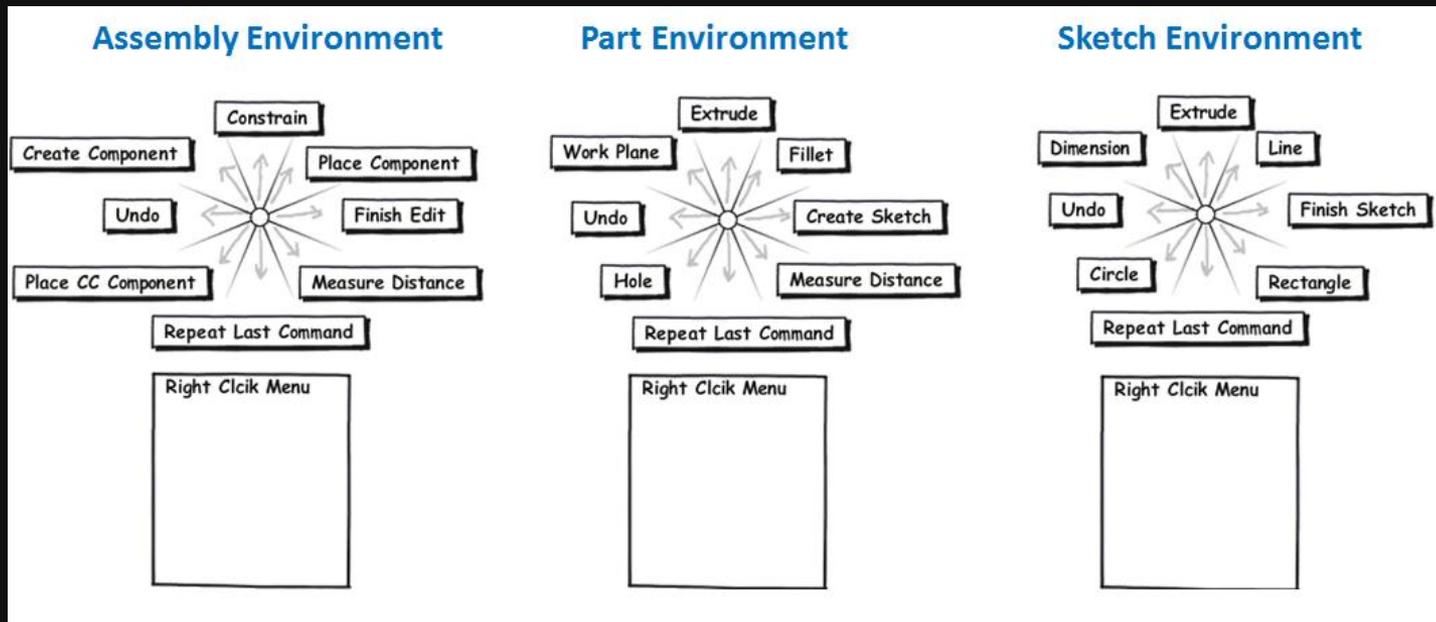
- *Reminder: Inventor has more than twenty task environments. Consequently, learning the menus will likely be get in the way of user adoption.*
- Consistent command locations help users to learn to use the menu by accessing consistently located commands.
- Ensure consistency of commands across other Autodesk products





Design Concepts: Initial Menus

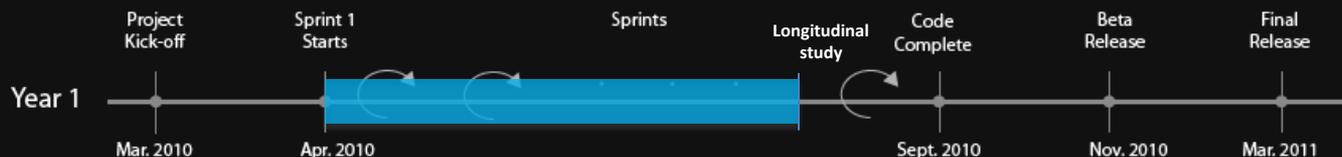
- Based on the usage patterns, we came up with some initial designs.





Research: Usability Sessions

- Usability Tests
 - Usability sessions performed every month between April to August
 - Approximately 40 users, total
 - Fairly informal with internal and external users
- The design was tested with the working code
 - The menu organization could be easily tweaked by the UX designer via xml file instead of going through development
- Usability feedback was directly circled back to the following sprint in agile process
- UX Designer (as a product owner) closely tracked the progress in the development

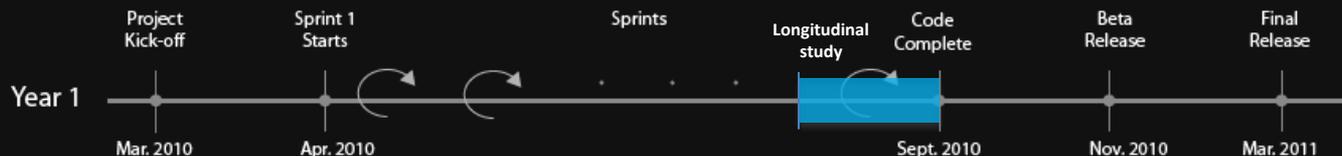




Research: Longitudinal Study

- To understand how users adapt to Marking Menus over time.
- Total 9 users were given a pre-beta build to use for a few weeks.
- Two check-in interviews and analytics provided data to answer critical questions like learnability of gestures.

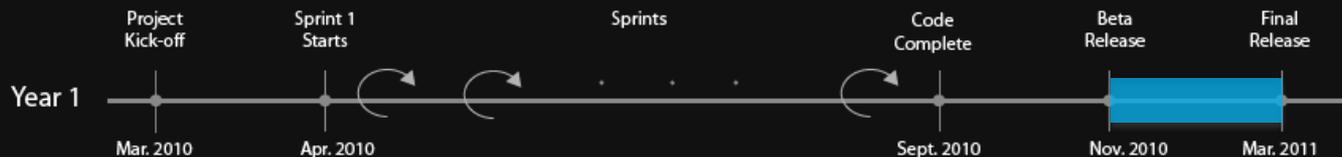
Timeline	Research Activity
	Users recruited via Inventor Beta site, given instructions about longitudinal study
Day 1	Selected user given access to Inventor pre-beta build; no prior instructions on marking menu. A set of basic tasks provided to complete during first week.
Day 8	1:1 remote interviews with users (30 min session) 15 min: User feedback on 2012 features including marking menus 15 min: Demo of gestures if user hasn't discovered.
Day 9-21	A second set of tasks provided via Beta site
Day 22	Final interview with participants





Research: Beta Survey

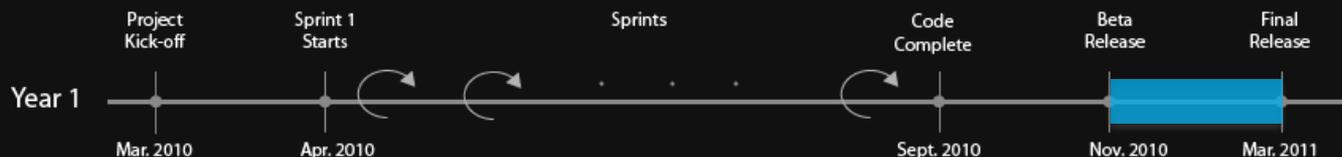
- Survey questions on ease of use, layout, learnability, productivity, and acceptance
- 103 survey respondents from the beta forum
- Results
 - 81% users responded they would use the Marking Menu as their default configuration.
 - 65% users foresee this enabling productivity gain





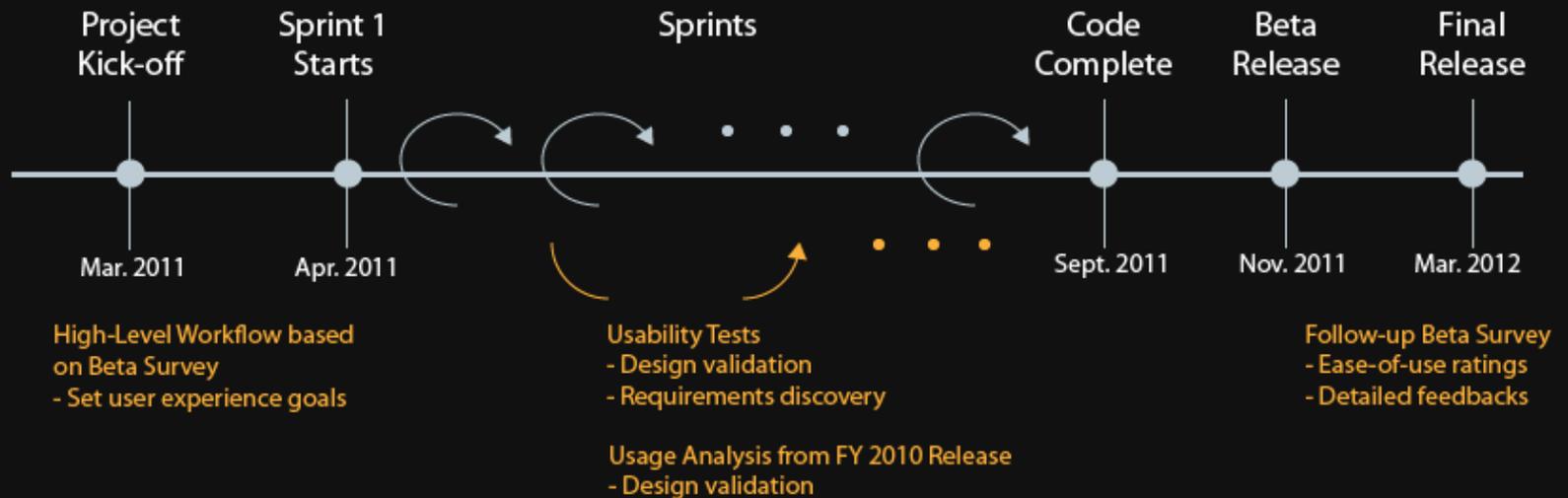
Beta Survey: Top 8 Issues

1. Learning curve
2. Visually complex and busy
3. Prone to mistakes and triggers commands unintended
4. Need more customization, e.g. my own menu
5. Consistency issues: Not all commands have the marking menu, some command locations are not consistent across environments.
6. Lack of context sensitivity: Want to have more relevant set of commands for selection.
7. Not as fast as hotkeys
8. Keyboard navigation does not work.





Year 2: Improvement based on user feedback





Beta Survey to Inform Following Release

- The top 8 issues resulted in prioritized list of enhancements.
- Created a high-level workflow that sets user experience goals for the entire team.

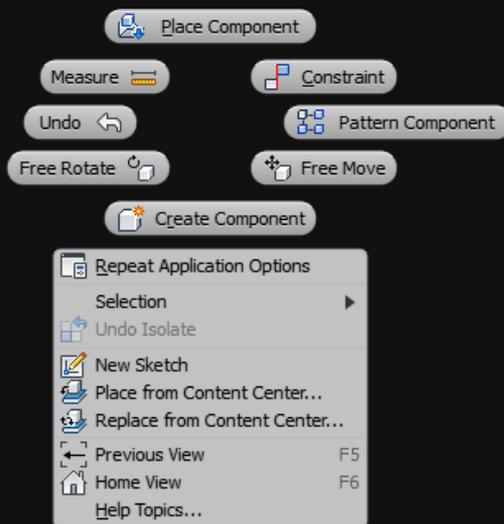




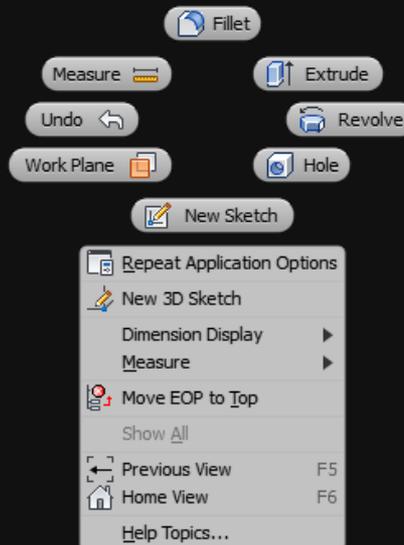
Final Design

- The location of commands are based on usage data and usability study.
- More contextual menus are added based on user feedback.

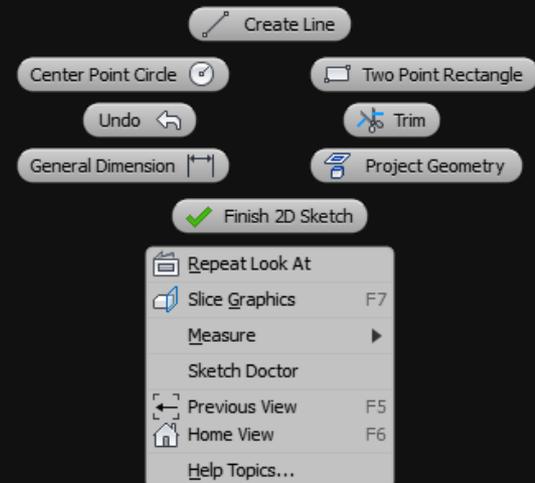
Assembly environment



Part environment



Sketch environment



Note: These three menus are sample menus. There are dozens more in the product.



Results of team efforts: The Good

- High adoption rate: 97% of users adopted marking menu as default (note: The product still can be used with the classic linear menu)
- Watching users mastering Marking Menus and using it as part of their creative design flow: [Click here for YouTube video from a user](#) 
- Defended decisions and delivered a great design for representative users rather than vocal few users who resist change.



Lessons Learned from Best Practices

- **Analysis of instrumented usage data**
 - Setting clear goals, asking right questions lead to insights from data.
 - The data does not represent the entire user workflow.
 - The initial design based on data must be verified with users.
 - The analysis confirmed 80/20 rule in our product.



Lessons Learned from Best Practices

- Iterative process and usability studies
 - Focus more on number of tests rather than quality of the test itself.
 - Keep cost of performing test as low as possible.
 - Don't dismiss the value of testing internal people.
 - Maintain accessibility to users by keeping persistent user portal, instead of Beta forum that is used only for a part of a year.
 - During test period, perform daily ad-hoc meeting to gather “observation nuggets” rather than extensive post-test analysis.
 - Follow-up the test findings with improvements in the following sprints.



Lessons Learned from Best Practices

- **Longitudinal study**
 - Rather costly process since the software at a certain quality had to be delivered to users.
 - Risk of disrupting users' work environment with the work-in-progress software that can cause crashes or loss of user data.
 - Need better tracking to understand their usage pattern.
- **Beta survey**
 - The survey helped building UX point of view on the final design solution.
 - The feedback from the beta users are close to the ones that we will receive when it is released to the public.



Look into Future

- **Trend : Desktop software trending towards online experience**
 - Rather than Beta test event every year, constantly engage users to receive feedback from the field
 - Rather than big release each year, deliver smaller chunk of updates more often
 - Rather than one-off batch delivery of usage data, live and more in-depth usage data
 - Learn from online product' s user research methods and apply it to the desktop software design
- ➔ They will make us more agile and help us to improve the iterative process.



Conclusion

- Data-driven design process resulted in the success in introduction of the new user interface, because:
 - The initial usage analysis was a reproducible process that any team member can follow to create menus for ~20 environments in Inventor.
 - Usability tests helped refining the design and identifying additional requirements.
 - The beta survey resulted in the high-level workflow that sets the UX goal for the entire project team.
- The case study presented the example of academic research result adopted by real world, large scale product, realizing its innovation.



Acknowledgement

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Thank You!

Questions