

Illustrating the Use of the Model

Part 1: Model Narrative

Type of Project

The project I will be estimating is an application called Pic Fit. To get a general understanding of the COCOMO Calculation I researched examples on how it worked [1]. This mobile application helps users pick out an outfit with clothes and accessories from their physical closet. A virtual closet is created for the user after they scan their clothing and accessories into the application. The application will be able to identify the type of clothing without user input using an IoT clothing database. Setting preferences are available for modification for the user. If these settings are default, Pic Fit will create an outfit based on the current trending fashion. Outfit options are generated based on the clothes available in the virtual closet. If the user does not like the generated outfit, they can modify it within the application until satisfied. Once the user is happy, they can build the ensemble in real life.

Mode and Size

Pic Fit will use a complex algorithm to suggest outfit options for the user. This project will require a highly experienced team to develop the outfit algorithm and external expertise on current trending fashion. Given the complexity of the criteria necessary for this application, I selected the embedded mode for the project mode.

Given the complexity and the functionality of the mobile application, I estimated the size of Pic Fit to be 150,000 lines of code.

Project Factors

One factor influencing product attributes is the access to the clothing database to determine the type of clothing the user is scanning with the application. Accessing the database causes the size of the database required by the application to be extra high. The algorithm used to generate outfits must be optimal enough for fast response times. This factor influences the computer turnaround time to be low and the execution time constraint to be on the higher end. As stated previously, utilizing a highly experienced team is necessary for the project and causes

the personnel attributes to be extra high. With a highly experienced team, the project attributes are also set on the higher end.

Estimation Report

COCOMO RESULTS for Pic Fit								
MODE	"A" variable	"B" variable	"C" variable	"D" variable	KLOC	EFFORT, (in person-months)	DURATION, (in months)	STAFFING, (recommended)
embedded	2.7153574504691798	1.2	2.5	0.32	150.000	1109.524	23.571	47.071
Explanation: The coefficients are set according to the project mode selected on the previous page, (as per Boehm). Note: the decimal separator is a period. The final estimates are determined in the following manner: $effort = a * KLOC^b$, in person-months, with KLOC = lines of code, (in thousands), and: $staffing = effort / duration$ where a has been adjusted by the factors:								

Product Attributes	
Required Reliability	1.40 (VH)
Database Size	1.16 (XH)
Product Complexity	1.30 (VH)
Computer Attributes	
Execution Time Constraint	1.11 (H)
Main Storage Constraint	1.56 (XH)
Platform Volatility	1.00 (N)
Computer Turnaround Time	0.87 (L)
Personnel Attributes	
Analyst Capability	0.71 (VH)
Applications Experience	0.82 (VH)
Programmer Capability	0.70 (VH)
Platform Experience	0.90 (H)
Programming Language and Tool Experience	0.95 (H)
Project Attributes	
Modern Programming Practices	0.82 (VH)
Use of Software Tools	0.83 (XH)
Required Development Schedule	1.00 (N)
New (Values are probably wrong)	
Required reusability	1.00 (N)
Documentation match to life-cycle needs	1.00 (N)
Personnel continuity	1.00 (N)
Multisite development	1.00 (N)

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SWL03_1_ApplicationName:Pic Fit
SWL03_1_ApplicationVersion:any
SWL03_1_ApplicationNumber:STRS-SUB-
SWL25_COCOMO_KLOC:150.000
SWL25_1_ApplicationSLOC:150000
SWL25_COCOMO_mode:embedded
SWL25_COCOMO_a:2.7153574504691798
SWL25_COCOMO_b:1.2
SWL25_COCOMO_c:2.5
SWL25_COCOMO_d:0.32
SWL25_COCOMO_e_effort:1109.524 (person-months)
SWL25_2_ApplicationLevelOfEffort:1109.524 (person-months)
SWL25_COCOMO_t_duration:23.571 (months)
SWL25_2_ApplicationTime:23.571 (months)
SWL25_COCOMO_eot_staff:47.071 (recommended)
SWL25_COCOMO_Required Reliability:1.40 (VH)
SWL25_COCOMO_Database Size:1.16 (XH)
SWL25_COCOMO_Product Complexity:1.30 (VH)
SWL25_COCOMO_Execution Time Constraint:1.11 (H)
SWL25_COCOMO_Main Storage Constraint:1.56 (XH)
SWL25_COCOMO_Platform Volatility:1.00 (N)
SWL25_COCOMO_Computer Turnaround Time:0.87 (L)
SWL25_COCOMO_Analyst Capability:0.71 (VH)
SWL25_COCOMO_Applications Experience:0.82 (VH)
SWL25_COCOMO_Programmer Capability:0.70 (VH)
SWL25_COCOMO_Platform Experience:0.90 (H)
SWL25_COCOMO_Programming Language and Tool Experience:0.95 (H)
SWL25_COCOMO_Modern Programming Practices:0.82 (VH)
SWL25_COCOMO_Use of Software Tools:0.83 (XH)
SWL25_COCOMO_Required Development Schedule:1.00 (N)
SWL25_COCOMO_Required reusability:1.00 (N)
SWL25_COCOMO_Documentation match to life-cycle needs:1.00 (N)
SWL25_COCOMO_Personnel continuity:1.00 (N)
SWL25_COCOMO_Multisite development:1.00 (N)
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STRS_RepMgrSeeStep:17f
STRS_FileNameOfPage:STRS COCOMO Calculation.html
Suggest_File_Name:2022-04-11_233706_Pic_Fit-COCOMO-1.txt
STRS_VersionOfPage:Feb 6, 2015 10:30 ET
subject:STRS COCOMO Calculation

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Displayed on this page are the estimation results for Pic Fit.

Part 2: Worst Case Scenario

Cost Drivers Adjustments

To create a worst-case scenario with the same size and project mode, I input product attributes the same as the original estimation from part 1 since the project's scope would not change. The only computer attribute that changed for this case was computer turnaround time. Slow computer response time impacts the developer's ability to develop and maintain the project time-wise. As stated in part one, Pic Fit ideally requires an experienced team to develop the project due to its complex factors. For this part, personnel attributes were each inputted as very low. Hiring an inexperienced team impacts the duration of time and effort needed to complete a complex project. Not having access to or lacking technology helpful in development hinders a team's ability to produce a complex application. All the attributes described in this section are displayed in the image to the right.

<input type="radio"/> Organic Mode: Relatively small, simple software projects in which small teams with good application experience work to a set of less than rigid requirements. <input type="radio"/> Semi-detached Mode: An intermediate, (in size and complexity), software project in which teams with mixed experience levels must meet a mix of rigid and less than rigid requirements. <input checked="" type="radio"/> Embedded Mode: A software project that must be developed within a set of tight hardware, software and operation constraints.	Application name: <input type="text" value="Pic Fit Worst Case"/> SLOC estimate: <input type="text" value="150000"/> <input type="button" value="Calculate COCOMO"/> <input type="button" value="Reset"/>
Acronyms used below: VL - Very Low L - Low N - Nominal H - High VH - Very High XH - extra High Note that the buttons below can be clicked for more (popup) information. More instructions below.	
Product Attributes <input type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input checked="" type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Required Reliability"/> <input type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input checked="" type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Database Size"/> <input type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input checked="" type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Product Complexity"/>	
Computer Attributes <input type="radio"/> VL <input type="radio"/> L <input checked="" type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Execution Time Constraint"/> <input type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input checked="" type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Main Storage Constraint"/> <input type="radio"/> VL <input type="radio"/> L <input checked="" type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Platform Volatility"/> <input type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input checked="" type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Computer Turnaround Time"/>	
Personnel Attributes <input checked="" type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Analyst Capability"/> <input checked="" type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Applications Experience"/> <input checked="" type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Programmer Capability"/> <input checked="" type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Platform Experience"/> <input checked="" type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Programming Language and Tool Experience"/>	
Project Attributes <input checked="" type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Modern Programming Practices"/> <input checked="" type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Use of Software Tools"/> <input checked="" type="radio"/> VL <input type="radio"/> L <input type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Required Development Schedule"/>	
New (Values are probably wrong) <input type="radio"/> VL <input type="radio"/> L <input checked="" type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Required reusability"/> <input type="radio"/> VL <input type="radio"/> L <input checked="" type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Documentation match to life-cycle needs"/> <input type="radio"/> VL <input type="radio"/> L <input checked="" type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Personnel continuity"/> <input type="radio"/> VL <input type="radio"/> L <input checked="" type="radio"/> N <input type="radio"/> H <input type="radio"/> VH <input type="radio"/> XH: <input type="button" value="Multisite development"/>	

Estimation Report

COCOMO RESULTS for Pic Fit Worst Case							
MODE	"A" variable	"B" variable	"C" variable	"D" variable	KLOC	EFFORT, (in person-months)	DURATION, (in months)
embedded	95.13140950693149	1.2	2.5	0.32	150,000	38871.692	73.557
Explanation: The coefficients are set according to the project mode selected on the previous page, (as per Boehm). (Note: the decimal separator is a period. The final estimates are determined in the following manner: $effort = a * KLOC^b$, in person-months, with KLOC = lines of code, (in thousands), and: $staffing = effort / duration$ where a has been adjusted by the factors:							
Product Attributes							
Required Reliability							
Database Size							
Product Complexity							
Computer Attributes							
Execution Time Constraint							
Main Storage Constraint							
Platform Volatility							
Computer Turnaround Time							
Personnel Attributes							
Analyst Capability							
Applications Experience							
Programmer Capability							
Platform Experience							
Programming Language and Tool Experience							
Project Attributes							
Modern Programming Practices							
Use of Software Tools							
Required Development Schedule							
New (Values are probably wrong)							
Required reliability							
Documentation match to life-cycle needs							
Personal continuity							
Multiple development							
For further reading, see Boehm, "Software Engineering Economics"							
WARNING: If you see "NaN" or "undefined" in any field above, you have entered an INVALID value for KLOC or Mode! Hit the "BACK" button on your browser, hit the "RESET" button if you entered data previously, enter a DECIMAL NUMBER in the KLOC input text box and click on the appropriate mode!							
The project should save the results of this COCOMO calculation if needed to support its make or buy decision.							
Please send notice of any problems to: pic-fit-est-estimator-manage@mail.nasa.gov QASAA-Privacy-Policy-and-Information/Contact							
SW1203_1_Application/Name Pic Fit Worst Case							
SW1203_1_Application/Version any							
SW1203_1_Application/Number 3783-01B-							
SW1203_1_Application/KLOC 150,000							
SW1203_1_Application/LOC 120000							
SW1203_1_Application/Mode embedded							
SW1203_1_Application_a 95.13140950693149							
SW1203_1_Application_b 1.2							
SW1203_1_Application_c 2.5							
SW1203_1_Application_d 0.32							
SW1203_1_Application_e effort 38871.692 (person-months)							
SW1203_1_Application_f effort 38871.692 (person-months)							
SW1203_1_Application_g duration 73.557 (months)							
SW1203_1_Application_h 73.557 (months)							
SW1203_1_Application_i use staff 528.458 (person-months)							
SW1203_1_Application_j Required Reliability 1.40 (VH)							
SW1203_1_Application_k Database Size 1.18 (OH)							
SW1203_1_Application_l Product Complexity 1.30 (VH)							
SW1203_1_Application_m Execution Time Constraint 1.00 (N)							
SW1203_1_Application_n Main Storage Constraint 1.56 (OH)							
SW1203_1_Application_o Platform Volatility 1.00 (N)							
SW1203_1_Application_p Computer Turnaround Time 1.15 (VH)							
SW1203_1_Application_q Analyst Capability 1.44 (VL)							
SW1203_1_Application_r Applications Experience 1.20 (VL)							
SW1203_1_Application_s Programmer Capability 1.42 (VL)							
SW1203_1_Application_t Platform Experience 1.21 (VL)							
SW1203_1_Application_u Programming Language and Tool Experience 1.14 (VL)							
SW1203_1_Application_v Modern Programming Practices 1.24 (VL)							
SW1203_1_Application_w Use of Software Tools 1.24 (VL)							
SW1203_1_Application_x Required Development Schedule 1.23 (VL)							
SW1203_1_Application_y Required reliability 1.00 (N)							
SW1203_1_Application_z Documentation match to life-cycle needs 1.00 (N)							
SW1203_1_Application_aa Personal continuity 1.00 (N)							
SW1203_1_Application_ab Multiple development 1.00 (N)							
SW1203_1_Application_ac Which version COCOMO							
STR3_1_Application/Version 1.5							
STR3_1_Application/OffsetPage STR3 COCOMO Calculation.html							
Support_Files/Name 2022-04-11_210208_Pic_Fit_Worst_Case-COCOMO-1.m							
STR3_Versions/OffsetPage Feb 4, 2015 10:30 ET							
reference STR3 COCOMO Calculations							

Using the same size and project mode for the estimation resulted in several differences between the original estimation and this one, the worst-case scenario. The "A" variable changed from 2.715 to 95.131 and was the only letter variable that experienced a change. Variable B, C, and D stayed the same in both estimations. Efforts for in-person months experienced an increase of 37,762.168 months. This increase was caused by hiring an inexperienced team and the lack of technology available. The worst-case estimation of Pic Fit involved setting all the personnel and project attributes to be very low. The duration was also increased by about fifty months due to these attributes. The last difference within this estimation was the staffing required to complete the project. The staffing for the project juristically increased from about 47 people to about 528 people.

Part 3: Ideal Conditions Scenario

Cost Drivers Adjustments

To create a best-case scenario, 150,000 KLOC was input for size and used an embedded project mode. Personnel attributes were inputted the same as the original estimation from part 1 since the project's scope still would not change. Under product attributes, only platform volatility was modified and set to low from nominal. The original estimation for Pic Fit included an experienced team and the use of higher technology. Therefore, this best-case scenario's results were similar to those from part one. Project attributes were each input as extra high to create an ideal minimal time and effort scenario. Overall, the attributes and results for part 3 were very similar to part 1. Displayed in the image below are all the attributes described in this section.

COCOMO RESULTS for Pic Fit Best Case								
MODE	"A" variable	"B" variable	"C" variable	"D" variable	KLOC	EFFORT, (in person-months)	DURATION, (in months)	STAFFING, (recommended)
embedded	2.592970000000055	1.2	2.5	0.32	150,000	1061.814	23.242	45.685
Explanation: The coefficients are set according to the project mode selected on the previous page, (as per Bodin). Note: the decimal separator is a period. The final estimates are determined in the following manner: $effort = a * KLOC^b$, in person-months, with KLOC = lines of code, (in thousands), and: $staffing = effort / duration$ where a has been adjusted by the factors: <div>Product Attributes Required Reliability 1.40 (VH) Database Size 1.16 (OH) Product Complexity 1.30 (VH) Computer Attributes Execution Time Constraint 1.11 (H) Main Storage Constraint 1.56 (OH) Platform Volatility 0.87 (L) Computer Turnaround Time 0.87 (L) Personnel Attributes Analyst Capability 0.71 (VH) Applications Experience 0.82 (VH) Programmer Capability 0.70 (VH) Platform Experience 0.60 (H) Programming Language and Tool Experience 0.95 (H) Project Attributes Modern Programming Practices 0.82 (OH) Use of Software Tools 0.83 (OH) Required Development Schedule 1.10 (OH) New (Values are probably wrong) Required reusability 1.00 (N) Documentation match to life-cycle needs 1.00 (N) Personal continuity 1.00 (N) Multisite development 1.00 (N) For further reading, see Bodin, "Software Engineering Economics" WARNING: If you use "N/A" or "undefined" in any field above, you have entered an INVALID value for KLOC or Mode! Hit the "BACK" button on your browser, hit the "RESET" button if you entered data previously; enter a DECIMAL NUMBER in the KLOC input text box and click on the appropriate mode! The project should save the results of this COCOMO calculation if needed to support its make or buy decision.</div>								
Please send notice of any problem to: pic-fit-cocomo-manages@mail.nasa.gov (NASA Email Policy and Acronym Usage)								
SWL03 - Application Name Pic Fit Best Case SWL03 - Application Version ver SWL03 - Application Number STR3-512B SWL03 - COCOMO_KLOC 150,000 SWL25 - Application LOC 150000 SWL25 - COCOMO_mode embedded SWL25 - COCOMO_a = 2.592970000000055 SWL25 - COCOMO_b = 1.2 SWL25 - COCOMO_c = 2.5 SWL25 - COCOMO_d = 0.32 SWL25 - COCOMO_e_effort 1061.814 (person-months) SWL25 - Application_levelEffort 1061.814 (person-months) SWL25 - COCOMO_f_duration 23.242 (months) SWL25 - Application_TTime 23.242 (months) SWL25 - COCOMO_gw_staff 45.685 (recommended) SWL25 - COCOMO_Required Reliability 1.40 (VH) SWL25 - COCOMO_Database Size 1.16 (OH) SWL25 - COCOMO_Product Complexity 1.30 (VH) SWL25 - COCOMO_Execution Time Constraint 1.11 (H) SWL25 - COCOMO_Main Storage Constraint 1.56 (OH) SWL25 - COCOMO_Platform Volatility 0.87 (L) SWL25 - COCOMO_Computer Turnaround Time 0.87 (L) SWL25 - COCOMO_Analyst Capability 0.71 (VH) SWL25 - COCOMO_Applications Experience 0.82 (VH) SWL25 - COCOMO_Programmer Capability 0.70 (VH) SWL25 - COCOMO_Platform Experience 0.60 (H) SWL25 - COCOMO_Programming Language and Tool Experience 0.95 (H) SWL25 - COCOMO_Modern Programming Practices 0.82 (OH) SWL25 - COCOMO_Use of Software Tools 0.83 (OH) SWL25 - COCOMO_Required Development Schedule 1.10 (OH) SWL25 - COCOMO_Required reusability 1.00 (N) SWL25 - COCOMO_Documentation match to life-cycle needs 1.00 (N) SWL25 - COCOMO_Personnel continuity 1.00 (N) SWL25 - COCOMO_Multisite development 1.00 (N) STR3_WhatIsVersion COCOMO STR3_WhatIsRelease 1.7 STR3_PicFitVerPage STR3 COCOMO Calculation.html Suggest_File_Name 2022-04-12_180849_Pic_Fit_Best_Case-COCOMO-1.m STR3_VersionPage Feb 4, 2015 16:30 ET subject:STR3 COCOMO Calculations								

Estimation Report

Using the same project mode and the project size, the estimate for a best-case scenario was very similar to the first estimation displayed in part one. The "A" variable experienced a decrease of about 0.12, while the B, C, and D variables stayed the same. Efforts for the in person-months decreased from 1109.524 to 1061.814 in this estimation. Modifying the required development time under project attributes from nominal to extra high duration was impacted. This value resulted in a decrease from 23.571 to 23.242 months. The staffing for this project also experienced a minor reduction of 47.071 to 45.685 people.

References

1. Tomar, N. COCOMO 1/ COCOMO'81: Constructive Cost Estimation Model. *C-sharpcorner.com*, 2012. <https://www.c-sharpcorner.com/uploadfile/nipuntomar/cocomo-1-cocomo81-constructive-cost-estimation-model/>.