

-Estimate Formulas Capstone

Overview

A heavily used feature within Buildertrend is the ability to create an itemized estimate of the overall cost of the project. A user can specify the unit cost, quantity, and any markup applied to the cost item (amongst other fields). A limitation of the current implementation is that each of the values that get factored into the total cost must be specified explicitly for each line item. There is no way to easily handle values that are repeated for multiple line items or to base a field's value on a standard formula. For instance, if a builder has a standard markup for all equipment costs and decides to increase this value by 2%, the builder will be forced to find each equipment line item and update the markup percentage individually. Another common problem occurs when, after the initial estimate, it is decided to extend the living room by another foot. Since the square footage of the planned living room for a new home will determine how much flooring is needed as well as how much paint is needed, the builder will have to update both the flooring and paint line items to account for the updated size of the living room. To resolve this pain point, we like to allow a user to store and reuse parameters and formulas across multiple line items reducing the need for redundant updates across line items.

The goal of this project will be to create a proof of concept on how to implement parameters and formulas into our existing line item components. This includes how best to store and reuse any parameters and formulas, how to display these values to the user, how the UI for adding a formula for a field's calculation should be presented to the user, and how to handle the arithmetic and logic operations that make up a field's formula.

Project Scope

- Re-create a simplified version of our line item container on a sample site
- Create an interface to add and update parameter values
- Add logic to compute the following formula types
 - Addition/Subtraction
 - Multiplication/Division
 - Exponents
 - Square root
 - Conditional (If-Else) Statements
 - Min/Max
 - Rounding
- Allow formulas to be composable
- Create an interface for inserting parameters and formulas into the line item fields
- Determine how to store these values
 - Consider performance
 - Consider how best to display these formulas on a financial report

Technologies

- Client: React
- Server-side: .NET recommended as it mirrors our tech stack, but not a requirement if you feel more comfortable with other technologies
- Database: SQL recommended, but the only true requirement is it must be a relational database

High Level Plan

- Setup a project repo
- Setup architecture
 - Create a database
 - Stand up a webserver
 - Create a react app
- Recreate a basic version of our Line Item container as a react component
 - Don't get caught up having it match exactly. We are more concerned with functionality than styling (we use the [Ant Design UI Library](#) as the basis from most of our fields)
 - See References section below for the current design
 - Design wise, we are really only concerned with 'Unit Cost', 'Quantity', 'Builder Cost', 'Markup', and 'Cost Type'.
- Add functionality to calculate the 'Builder Cost' and 'Owner Price' fields
 - $\text{Builder Cost} = \text{Unit Cost} * \text{Quantity}$
 - $\text{Owner Price} = \text{Builder Cost} + \text{Markup}$
 - NOTE: Markup can be defined in 3 ways: Percentage of Builder Cost, Flat Rate, or Flat Rate per Unit
- Allow a user to save line items and retrieve/edit previously saved items
 - When determining the db schema for how these items are saved try to consider how the schema you choose will be affected when we start including parameters and formulas into the line item
- Add functionality to create/read/update/delete parameters
 - These will need to be stored in the DB
 - You can start by creating and API endpoints on your server which will perform these operations
- Create a UI for adding parameters
 - This can be a separate page from where you have your line item container
- Add the ability to add parameters into fields in the LIC
- Allow a user to save line items that include parameters
 - When these get saved, keep in mind that we need the field values that contain parameters to keep that relationship (ie. it is not enough to just save the value of the parameter when the line item is saved, we need to keep a reference to what param the field is using so if the parameter's value is changed the line item will be updated to reflect the change)
- Add logic to add and compute the following formula types inside line item fields

- Field Types:
 - Addition/Subtraction
 - Multiplication/Division
 - Exponents
 - Square root
 - Conditional (If-Else) Statements
 - Min/Max
 - Rounding
- Feel free to separate these out into separate milestone (e.g. a milestone might contain the implementation of Addition/Subtraction, Multiplication/division, Exponents, and Square Roots and a separate milestone by include the implementation of the other formulas)
- Allow a user to save line items that include formulas (including formulas with parameters)
- Allow a user to create parameterized formulas (i.e. formulas that can be saved off as parameters and referenced in LIC fields by the parameter name)
- Create a read-only report view which displays all line items
 - Consider how best to represent formulas and parameters in this view

References

Line Item Container (LIC)

Item	Cost Type	Unit Cost	Quantity	Unit	Builder Cost	Markup	Owner Price	Description
100 Buildstrand Flat Rate Selection Choice abc		\$0.00	1	--	\$0.00	\$0.00	\$0.00	--
100 Buildstrand Flat Rate Selection Choice abc		\$0.00	1	--	\$0.00	\$0.00	\$0.00	--
100 Buildstrand Flat Rate Selection Choice abc		\$0.00	1	--	\$0.00	\$0.00	\$0.00	--
100 Buildstrand Flat Rate Selection Choice 1		\$300.00	1	--	\$500.00	\$0.00	\$500.00	--
100 Buildstrand Flat Rate Selection Choice Choice 2		\$0.00	1	--	\$0.00	\$0.00	\$0.00	--
100 Buildstrand Flat Rate Est abcED		\$700.00	1	--	\$700.00	21.00%	\$847.00	--
THE HOME DEPOT								
						\$100,902.00	\$100,016.60	

Item	Cost Type	Unit Cost	Quantity	Unit	Builder Cost	Markup	Owner Price	Description
1000 - 1999 PREPARATION PRELIMINARIES								
abc 1010 - Building permits	<input type="checkbox"/> Labor <input type="checkbox"/> Material <input type="checkbox"/> Equipment	\$20.00	1	--	\$20.00	546.00%	\$129.20	Lorem ipsum dolor sit amet, consectetur adipiscing elit. Praesent tempus congue... Show More

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Item	Cost Type	Unit Cost	Quantity	Unit	Builder Cost	Markup	Owner Price	Description
1000 - 1999 PREPARATION PRELIMINARIES								
abc 1010 - Building permits	Labor Material Equipment	\$ 20.0000	1,0000		\$20.00	\$46.00 %	\$ 129.20	Lorem ipsum dolor sit amet, consectetur adipiscing elit. Praesent tempus congue placerat. Sed vel suscipit diam. Pellentesque venenatis tortor at feugiat suscipit. Sed non
1000 - 1999 PREPARATION PRELIMINARIES								
abc 1010 - Building permits	Labor Material Equipment	\$ 20.0000	1,0000		\$20.00	\$46.00 %	\$ 129.20	Lorem ipsum dolor sit amet, consectetur adipiscing elit. Praesent tempus congue placerat. Sed vel suscipit diam. Pellentesque venenatis tortor at feugiat suscipit. Sed non
1000 - HBA assessments		\$0.00	1	--	\$0.00	0.00%	\$0.00	--

Report

Price Breakdown				
Group Price: \$47,927.84				
Code	Description	Qty / Unit	Unit Price	Price
1490 - Other utility connections		15	\$100.00	\$1,500.00
Buildertrend Flat Rate		1	\$15,000.00	\$15,000.00
2110 - Concrete block	test	1	\$10.00	\$10.00
2120 - Rough grading		1	\$0.00	\$0.00
2130 - Window wells		1	\$0.00	\$0.00
2200 - Waterproofing		1	\$0.00	\$0.00
2300 - Termite protection		1	\$0.00	\$0.00
3100 - Structural steel		1	\$0.00	\$0.00
3110 - Lumber—1st package		1	\$0.00	\$0.00
3140 - Trusses		1	\$0.00	\$0.00
3150 - Miscellaneous lumber		1	\$0.00	\$0.00
3210 - Framing labor—draw #1		1	\$0.00	\$0.00
3220 - Framing labor—draw #2		1	\$0.00	\$0.00
3230 - Framing labor—draw #3		1	\$0.00	\$0.00
2200 - Windows		1		

Parameter & Formula Examples

- <https://www.coconstruct.com/learn-construction-software/utilizing-parameters-for-estimating>
- <https://www.coconstruct.com/learn-construction-software/calculating-quantities-with-formulas-equations>
- https://news.udatechnologies.com/advanced-calculation-methods-improve-accuracy-of-construction-takeoff-measurements?_hstc=188231159.18742ed972c8085ced1b4de884a952d7.1604518717760.1609791333768.1611343379092.9&_hssc=188231159.1.1611343379092&_hsfp=209668515
- <https://www.provia.com/stone-calculator>

- https://www.youtube.com/watch?v=sxRZSw6dZvQ&feature=emb_logo
- https://www.youtube.com/watch?v=BJxE4nYXLkE&feature=emb_logo
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