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**Date:** September 25, 2018

**To:** Bond Accountability Committee

**From:** Dan Jung

**Subject:** Value Engineering and Cost Analysis

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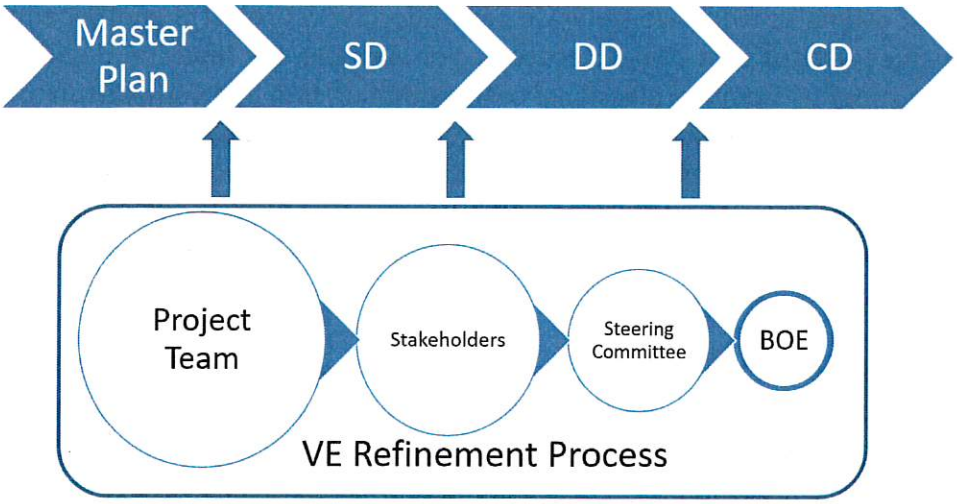
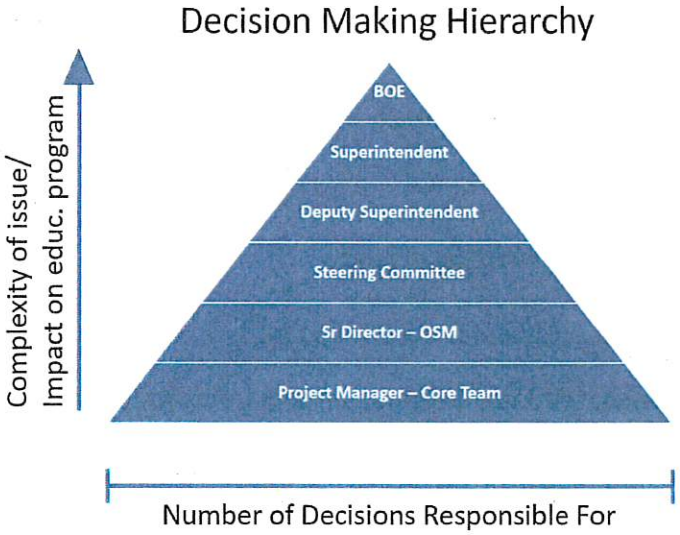
Over the last several months, OSM has been presenting information to the BAC about project costs. Given the rising costs of construction in the region, one question that consistently arises during the presentations has to do with understanding OSM's value engineering and cost analysis processes.

OSM has a deliberate and exhaustive value engineering process that it follows for Bond projects. One baseline component of that process is repeated cost estimates, scheduled at regular intervals. Cost estimates are created at the end of every phase of design. The entire project team then sits down in a value engineering discussion to determine how to cut costs to stay on budget. The project is not allowed to move forward with the next phase of design until the budget, scope and schedule are re-aligned. This ensures that cost issues become visible as early as possible, and the team is able to address them systematically. The diagram below shows the iterative nature of this process.



As seen in the diagram above, not all value engineering decisions are made by the project team alone. Frequently, stakeholders need to be engaged to discuss how the design continues to meet, or deviates from, educational specifications or design guidelines. As issues become more complex, the project team uses the hierarchy shown below for making decisions on value engineering options.




One example of a cost issue that was addressed through this process is the Madison gym. Madison's Schematic Design Phase cost estimate identified that renovating the existing gym was a significant cost concern for the budget. Through a value engineering discussion, the project team determined it would be less expensive to demolish the existing gym and build a new one in its place. This was a significant change that did not, however, affect the educational specifications. Consistent with OSM's methodology for this type of change, the cost-savings option was reviewed with stakeholders and the Steering Committee before a decision was made to move forward with it. OSM then presented an update to the Board of Education regarding the decision.

The use of cost estimates from two separate parties for every project is another component of the value engineering and cost analysis process. For example, the Madison High School project team is using estimates from a professional cost estimating firm as a comparison to cost estimates received from the contracted CM/GC. Cost estimates are provided by both parties on the same timeline, then reconciled for scope, understanding and methodology. The two estimates must reconcile within 10% of each other before the project can continue moving forward. This shows OSM that multiple independent parties have concurred on the validity of the costs for the work involved.

In addition to these standard value engineering and cost analysis measures, OSM has begun contracting with outside parties for constructability reviews during the design phase of the 2017 Bond projects. These reviews bring in construction contractors from outside the project team, to review design documents for completeness, constructability, and potential cost savings measures. The first of these constructability reviews is currently underway with the

Kellogg Middle School project and has already shown potential savings opportunities that the project team is reviewing.

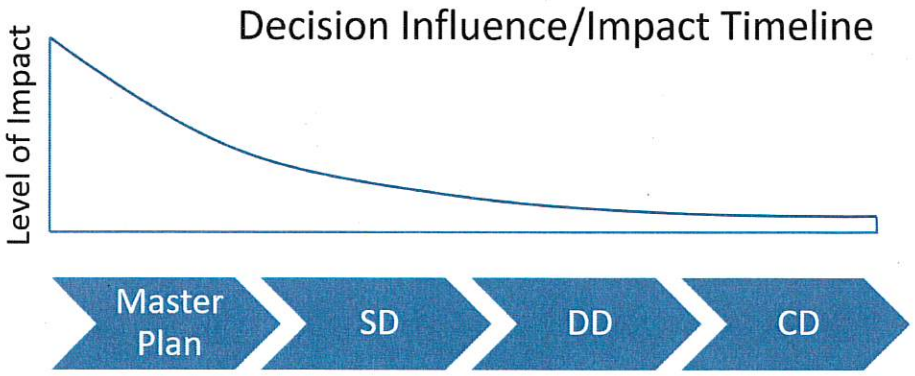
OSM is also piloting a facilitated Value Methodology process for the Lincoln High School project, using a professional value engineering firm. Certified Value Specialists from the firm will facilitate workshops using a rigorous framework to identify, prioritize, and make decisions on value engineering opportunities. These workshops will take place during Schematic Design and Design Development to ensure that opportunities are identified early in the design process for best value enhancement. OSM is interested in comparing this approach to the standard value engineering approach noted above. Outcomes may include using this approach again for future projects or training OSM staff in the methodology in order to bring it in-house.

Although OSM already has several robust value engineering processes in use, OSM continues to evaluate new potential tools. At the July 18, 2018, Bond Advisory Committee meeting, OSM presented a project cost analysis method that OSM was developing as a potential value engineering tool to be used in conjunction with OSM's standard value engineering processes. This cost analysis method broke down cost estimates for the high school modernization projects into CSI MasterFormat divisions and looked at costs by division as a percentage of the total.



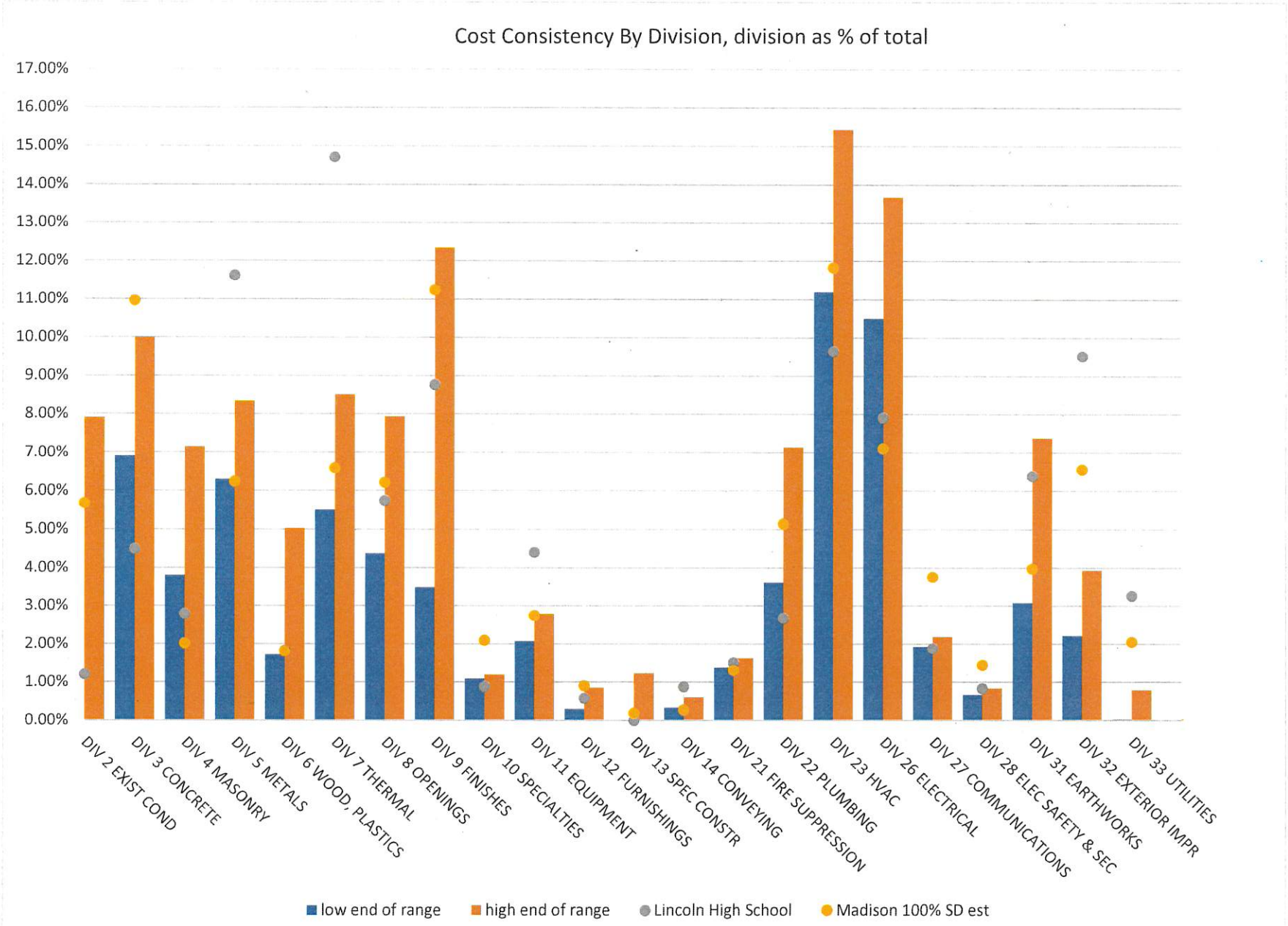
Using the 2012 Bond Program high school projects as reference points for low and high costs in each division to create a range, OSM graphed the division costs for the 2017 Bond Program projects of Madison High School and Lincoln High School. OSM then analyzed any points that fell outside the range of the 2012 reference projects, to look for specific cost concerns or unique project scope that may have created the outliers. Attached to this memo are the initial graph of the costs by division and the results of the analysis by project by division.

This tool, while limited by the accuracy and amount of historical data, can provide a quick method for identifying broad areas of concern. This then allows for more focused review of those areas. It is best used early in the design process as a way to help shape developing discussions of materials and systems. It becomes less valuable as an iterative process or towards the end of the design phase. OSM will continue to evaluate its usefulness in future projects.



As seen in several of the value engineering and cost analysis process descriptions above, the best value of all of these processes comes through timely decisions in the early phases of a project. Early design phases have more flexibility to make significant changes with minimal re-work. This improves budget value and helps maintain schedule alignment. OSM utilizes several value engineering and cost analysis processes throughout the project, with the understanding that value engineering occurring in the earliest phases will have the greatest impact on costs. As the project moves through design, value engineering refinement will necessarily result in smaller cost impacts.

OSM appreciates the support of the Bond Advisory Committee as OSM continues to review and improve its value engineering and cost analysis methods.


Cost Consistency By Division, division as % of total
17.00%
16.00%
15.00%
14.00%
13.00%
12.00%
11.00%
10.00%
9.00%
8.00%
7.00%
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
DIV 2 EXIST COND
DIV 3 CONCRETE
DIV 4 MASONRY
DIV 5 METALS
DIV 6 WOOD, PLASTICS
DIV 7 THERMAL
DIV 8 OPENINGS
DIV 9 FINISHES
DIV 10 SPECIALTIES
DIV 11 EQUIPMENT
DIV 12 FURNISHINGS
DIV 13 SPEC CONSTR
DIV 14 CONVEYING
DIV 21 FIRE SUPPRESSION
DIV 22 PLUMBING
DIV 23 HVAC
DIV 26 ELECTRICAL
DIV 27 COMMUNICATIONS
DIV 28 ELEC SAFETY & SEC
DIV 31 EARTHWORKS
DIV 32 EXTERIOR IMPR
DIV 33 UTILITIES
low end of range
high end of range
Lincoln High School
Madison 100% SD est

Cost Consistency by Division, division as percentage of total - Outlier Analysis

| | MADISON |
|---|---|
| Divison 2<br>*Demolition*<br>*Lead/Asbestos* | MID<br>While not High, these costs have been reduced 20% as part of VE efforts after the initial cost review (at 100% SD). |
| Division 3<br>*Concrete*<br>*Rebar*<br>*Structural FRP*<br>*Shotcrete* | **HIGH**<br>During cost review, extensive use of structural FRP was noted as a high-cost item in Div 3. After VE efforts and a peer review by structural engineers KPFF, costs were reduced 17%. If you add structural divisions 3, 4, and 5 together, Madison is nearly identical to Grant on a cost/SF basis and is 10% less than Franklin. |
| Division 4<br>*Masonry (New)*<br>*Masonry (Restoration)*<br>*Masonry Cleaning* | LOW<br>As currently designed, there is minimal masonry (as a structural system or skin), so this number is expected to be low. This may change as the design is refined. |
| Division 5<br>*Structural Steel*<br>*Steel Decking*<br>*Metal Stairs & Fab* | LOW<br>As currently designed, structural system is primarily concrete, not steel, so this number is expected to be low. |
| Division 6<br>*Rough Carpentry*<br>*Finish Carpentry* | MID<br>Madison is in line with typical percentages. Costs were reviewed but no significant value engineering options were noted. |
| Division 7<br>*Waterproofing*<br>*Insulation*<br>*Metal Wall Panels*<br>*Roofing*<br>*Fireproofing* | MID<br>Madison is in line with typical percentages. Costs were reviewed but no significant value engineering options were noted. |
| Division 8<br>*Windows*<br>*Aluminum Storefront*<br>*Curtainwall*<br>*Doors* | MID<br>Cost review did not identify any unusual cost deviations. As the project team continues to refine the design, these numbers may change due to changes in amount of glazing or openings versus solid walls. |
| Division 9<br>*Gypsum/Plaster*<br>*Ext Metal Stud Framing*<br>*Tile, Carpet, Resilient Flr*<br>*Wood Gym/Theater Floor*<br>*Acoustic Treatments* | MID<br>This division is on the higher end of the range and is targeted for VE options during design development. The project team will, in particular, further examine costs/scope for wood floors and acoustic walls, as a result of the cost review. |
| Division 10<br>*Visual Display Boards*<br>*Signage*<br>*Toilet Accessories*<br>*Operable Partitions*<br>*Lockers* | **HIGH**<br>Items such as signage and operable partitions were noted during cost review as worth examining for scope. Many of these items have not been defined yet in the design so the contractor's estimate kept conservative placeholders to cover a range of options for these items. During design development, these numbers will be refined. |
| Division 11<br>*Projection Screens*<br>*Science Equipment*<br>*Food Service Equipment*<br>*Gym/Theater Equipment* | MID<br>Similar to Division 10, scope and costs for these items will be further refined during design development. The team will be looking particularly at gym and theater equipment scope/cost assumptions, as a result of the cost review. |

| | MADISON |
|---|---|
| Division 12<br>*Window Shades*<br>*Specialty Casework*<br>*Site Furnishings* | **HIGH**<br>Many of these items have not been defined yet in the design so the contractor's estimate kept conservative placeholders for these items. The team expects more detail during design development will refine the numbers. It's also worth noting that other projects included manufactured casework in Division 6, not 12, so this is likely also a difference in bucketing. |
| Division 13<br>*Special Construction* | N/A<br>This division is currently acting as a holder for room fit-out costs that would typically be distributed among different divisions. Once the design is further developed, the costs will be redistributed where appropriate. |
| Division 14<br>*Elevators* | LOW<br>Madison only has two elevators and cost review did not identify any unusual cost deviations in this division. No significant value engineering options were noted. |
| Division 21<br>*Fire Suppression* | LOW<br>Cost review did not identify any unusual cost deviations. No significant value engineering options were noted. |
| Division 22<br>*Plumbing* | MID<br>There can be discrepancies in how different projects allocate costs to Div 22 and Div 23. As a combined percentage of the two divisions, Madison would show as Low. Cost review did not identify any unusual cost deviations, but an upcoming constructability review by an outside contractor will also look at this scope. |
| Division 23<br>*HVAC Systems* | MID<br>There can be discrepancies in how different projects allocate costs to Div 22 and Div 23. As a combined percentage of the two divisions, Madison would show as Low. Cost review did not identify any unusual cost deviations, but an upcoming constructability review by an outside contractor will also look at this scope. |
| Division 26<br>*Electrical Systems*<br>*Lighting*<br>*PV Systems* | LOW<br>Division 26 is often used for primary infrastructure for Div 27 and Div 28 items. With Div 26 showing Low and Divs 27 and 28 showing High for Madison, there is a likely discrepancy in how the different projects bucketed these costs. If reviewed across the three divisions as a whole, Madison would be categorized at the low end of Mid. |
| Division 27<br>*Communications*<br>*AV Systems*<br>*DAS* | **HIGH**<br>Division 26 is often used for primary infrastructure for Div 27 and Div 28 items. With Div 26 showing Low and Divs 27 and 28 showing High for Madison, there is a likely discrepancy in how the different projects bucketed these costs. If reviewed across the three divisions as a whole, Madison would be categorized at the low end of Mid. |
| Division 28<br>*Access Control*<br>*Video Surveillance*<br>*Fire Detection & Alarm* | **HIGH**<br>Division 26 is often used for primary infrastructure for Div 27 and Div 28 items. With Div 26 showing Low and Divs 27 and 28 showing High, there is a likely discrepancy in how the different projects bucketed these costs. If reviewed across the three divisions as a whole, Madison would be categorized at the low end of Mid. |
| Division 31<br>*Earth Moving*<br>*Excavation & Backfill*<br>*Erosion Control*<br>*Shoring, Piles* | MID<br>Madison's costs included 287 micropiles drilled 60 ft deep, and substantial earth moving, due to existing site slope and soil conditions. |
| Division 32<br>*Curbs, Gutters, Walks*<br>*Fencing*<br>*Plants and Irrigation*<br>*Site Furnishings* | **HIGH**<br>Madison's scope includes all-new softball field, turf, and supporting structures (more scope than the reference projects). It also has significant City-required improvements along 82nd. |
| Division 33<br>*Site Water*<br>*Site Sanitary*<br>*Site Storm*<br>*Site Lighting* | **HIGH**<br>Sloping site requires some utility connections to come from two different locations.<br>Stormwater costs are currently assuming the worst case scenario that all existing dry wells have to be replaced (pending testing). |

Cost Consistency by Division, division as percentage of total - Outlier Analysis

| | LINCOLN |
|---|---|
| Divison 2<br>*Demolition*<br>*Lead/Asbestos* | LOW<br>Cost review noted that the construction cost estimate does not include hazardous material abatement, which may cause this division to be low. Project team has indicated budget for abatement is currently being held in Owner's Cost portion of the project budget (outside these divisions), and will be moved to the contractor's cost portion (Division 2) in the upcoming cost estimate. |
| Division 3<br>*Concrete*<br>*Rebar*<br>*Structural FRP*<br>*Shotcrete* | LOW<br>As currently designed, structural system is primarily steel, not concrete, so this number is expected to be low. |
| Division 4<br>*Masonry (New)*<br>*Masonry (Restoration)*<br>*Masonry Cleaning* | LOW<br>As currently designed, there is minimal masonry (as a structural system or skin), so this number is expected to be low. This may change as the design is refined. |
| Division 5<br>*Structural Steel*<br>*Steel Decking*<br>*Metal Stairs & Fab* | **HIGH**<br>Lincoln has high Div 5 costs due to building height and structural system (large quantities of structural steel, steel roofing, steel decking). This includes high costs for metal stairs (due to height). |
| Division 6<br>*Rough Carpentry*<br>*Finish Carpentry* | MID<br>Lincoln is in line with typical percentages. Costs were reviewed but no significant value engineering options were noted. |
| Division 7<br>*Waterproofing*<br>*Insulation*<br>*Metal Wall Panels*<br>*Roofing*<br>*Fireproofing* | **HIGH**<br>As currently designed, a substantial amount of the cost is from composite metal panels, composite metal soffits and custom GFRC. After review of costs, PM has directed design team to look at skin alternates such as masonry that might be lower cost but still meet City design requirements.<br>The roof has a green roof requirement from City of Portland, which creates higher costs in this division.<br>The high quantity/cost of fireproofing is to be expected, due to the amount of structural steel. |
| Division 8<br>*Windows*<br>*Aluminum Storefront*<br>*Curtainwall*<br>*Doors* | MID<br>Lincoln has all new windows, storefront, curtainwall and doors, because it is all new construction. City design requirements also impact the amount of glazing required in the project. The "low" reference project in this division is Roosevelt, which refurbished its existing windows rather than install all new. Lincoln's proportion of glazing to solid skin may change as the design is refined. |
| Division 9<br>*Gypsum/Plaster*<br>*Ext Metal Stud Framing*<br>*Tile, Carpet, Resilient Flr*<br>*Wood Gym/Theater Floor*<br>*Acoustic Treatments* | MID<br>The "low" reference project in this division is Franklin, which minimized changes to existing walls as a VE strategy. Lincoln's percentage in this division is lower than both Roosevelt and Grant. |
| Division 10<br>*Visual Display Boards*<br>*Signage*<br>*Toilet Accessories*<br>*Operable Partitions*<br>*Lockers* | LOW<br>Some of these items go through FF&E (owner's cost, not shown in this division) such as toilet accessories. Cost review noted that visual display boards are currently estimated low, however at this point of the design, these types of items are not yet fully specified. Cost is being held per standard practice in design contingency (outside these construction divisions, but within the project budget) and will be transferred in future estimates as the design is refined. |
| Division 11<br>*Projection Screens*<br>*Science Equipment*<br>*Food Service Equipment*<br>*Gym/Theater Equipment* | **HIGH**<br>Cost review noted a high value line item for AV equipment that needed clarification. AV equipment is typically purchased by the owner, not the contractor. Project team has indicated this line item does appear to be duplicated in the owner's cost budget for equipment, and has targeted this item for review and reduction as needed. |

| | LINCOLN |
|---|---|
| Division 12<br>*Window Shades*<br>*Specialty Casework*<br>*Site Furnishings* | MID<br>Cost review did not identify any costs as unusual. Lincoln's division percentage is tightly clustered below Grant and Roosevelt. |
| Division 13<br>*Special Construction* | N/A |
| Division 14<br>*Elevators* | **HIGH**<br>Lincoln has five elevators, with 7 stops due to height of building. No other project has this height or number of elevators. |
| Division 21<br>*Fire Suppression* | MID<br>Cost review did not identify any unusual cost deviations. Fire suppression is typically more extensive for midrise buildings than lowrise buildings. |
| Division 22<br>*Plumbing* | LOW<br>Cost review did not identify any unusual cost deviations. Costs are likely low because plumbing systems can be designed and constructed more efficiently in new buildings than remodels. |
| Division 23<br>*HVAC Systems* | LOW<br>Cost review did not identify any unusual cost deviations. Costs are likely low because HVAC systems can be designed and constructed more efficiently in new buildings than remodels. |
| Division 26<br>*Electrical Systems*<br>*Lighting*<br>*PV Systems* | LOW<br>Cost review did not identify any unusual cost deviations. Costs are likely low because electrical systems can be designed and constructed more efficiently in new buildings than remodels. |
| Division 27<br>*Communications*<br>*AV Systems*<br>*DAS* | LOW<br>Cost review did not identify any unusual cost deviations. Costs are likely low because communications systems can be designed and constructed more efficiently in new buildings than remodels. |
| Division 28<br>*Access Control*<br>*Video Surveillance*<br>*Fire Detection & Alarm* | MID<br>Cost review did not identify any unusual cost deviations. Fire detection and alarm is typically more extensive for midrise buildings than lowrise buildings. |
| Division 31<br>*Earth Moving*<br>*Excavation & Backfill*<br>*Erosion Control*<br>*Shoring, Piles* | MID<br>Lincoln's costs included 450 piles drilled 90 ft deep, and substantial earth moving. In addition to pilings for the building, large retaining walls (there is significant slope across the site) also require pilings. The project team is working to reduce earthwork export by raising elevation of the track and field. |
| Division 32<br>*Curbs, Gutters, Walks*<br>*Fencing*<br>*Plants and Irrigation*<br>*Site Furnishings* | **HIGH**<br>Lincoln has to build all new athletic facilities and outbuildings (no re-use of existing site facilities is possible). This is significantly more scope than the reference projects. |
| Division 33<br>*Site Water*<br>*Site Sanitary*<br>*Site Storm*<br>*Site Lighting* | **HIGH**<br>Lincoln has to build completely new site utilities, with high SD complexity due to City permit reqs. Upgrading/repair of city utilities on site is required for work over the utility easements in the vacated right of way on 16th and 17th avenues. |