Supplemental Material

S1 Summary of Predictive CAD Problem Definition in the Literature

Table 6: Summary of predictive CAD problem definition in the literature

Characteristic	Source of Experience	Scope of Functionality	Style of Learning	Extent of Locations	Completeness of Shapes	Scope of Sequences	Scope of Motif	Scope of Inference
Authors	Focus and Unfocused	Domain dependant and independent	Supervised and Unsupervised	Single-point and Multi-point suggestions	Feature and Component suggestions	Immediate and subsequent suggestion level	Presence and Occurrence patterns	Geometric and Semantic
Chaudhuri and Koltun (2010)	Unfocused	Dependent	Unsupervised	Multi-point	Component	Immediate	Presence	Geometric
Chaudhuri et al. (2011)	Unfocused	Dependant	Supervised	Multi-point	Component	Immediate	Occurrence	G & S
Lam et al. (2012)	Focus	Independent	Supervised	Single-point	Component	Immediate	Presence	G & S
Kalogerakis et al. (2012)	Focus	Dependant	Supervised	Multi-point	Component	Subsequent	Occurrence	G & S
Fisher et al. (2011)	Focus	Dependant	Supervised	Multi-point	Component	Subsequent	Occurrence	G & S
Chaudhuri et al. (2013)	Focus	Dependant	Supervised	Multi-point	Component	Immediate	Presence	G & S
Schulz et al. (2014)	Focus	Dependant	Supervised	Multi-point	Component	Subsequent	Occurrence	G & S
Liu et al. (2014)	Focus	Dependant	Supervised	Multi-point	Component	Subsequent	Occurrence	G & S
Jaiswal et al. (2016)	Unfocused	Dependant	Unsupervised	Multi-point	Component	Immediate	Occurrence	G & S
Sung et al. (2017)	Unfocused	Independent	Supervised	Multi-point	Component	Immediate	Occurrence	G & S
Li et al. (2017)	Focus	Dependant	Unsupervised	Multi-point	Component	Immediate	Occurrence	G & S

S2 Bayesian Network Structure for Valve Bodies

A BN structure that was learned using hole and cylindrical boss features extracted from valve bodies is shown below.

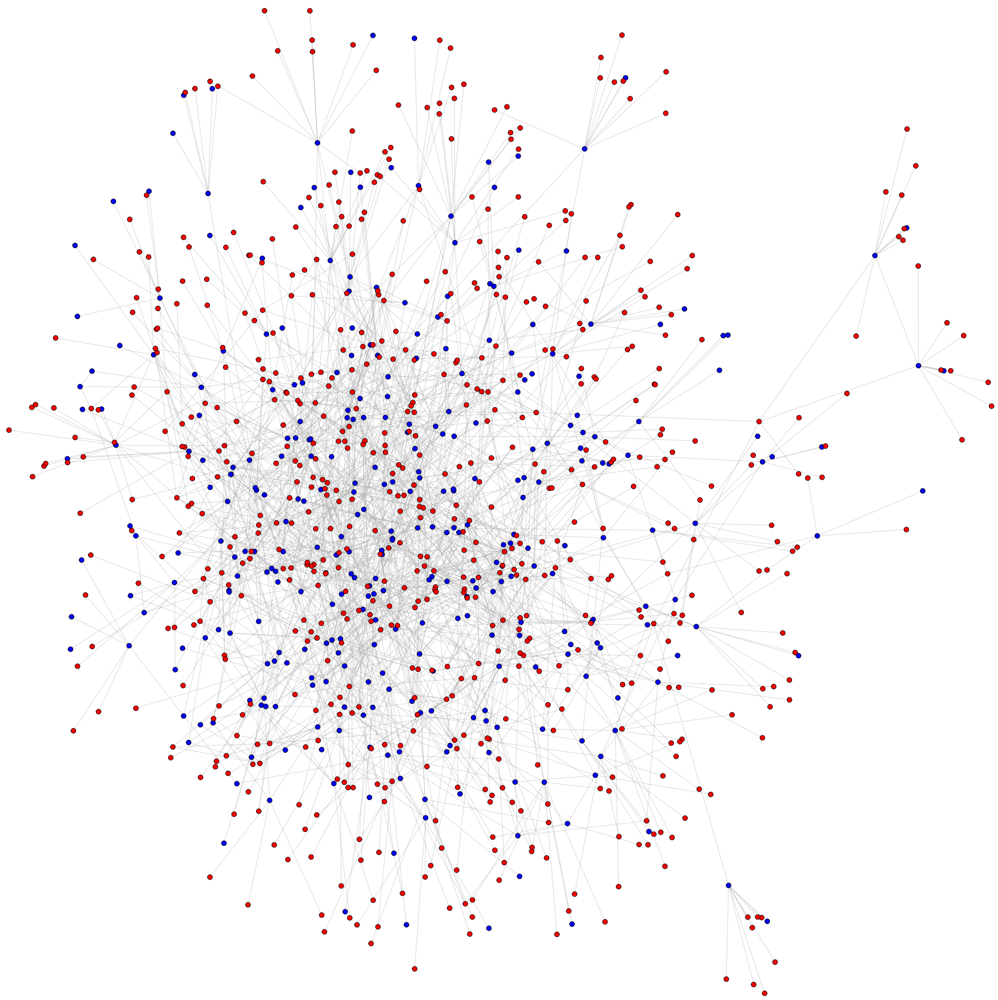

Figure 15: BN learned from the database of valve bodies. The edges between the nodes indicate direct associations, and the blue nodes represent the hole features and the red represent the bosses. (arrows showing the direction and node labels are suppressed for clarity)

S3 Additional Prediction Results from Valve Bodies

Precision@k and recall@k were calculated for a range of k from one to ten, which were then averaged across the ten folds for the sets of hole and boss features individually, which were extracted from the valve bodies designs. The ranking of the predictive performance between the algorithms are similar to the combined analysis on the valve bodies, with BNs and NNs outperforming the N-Gram model as additional features are included in a new design.

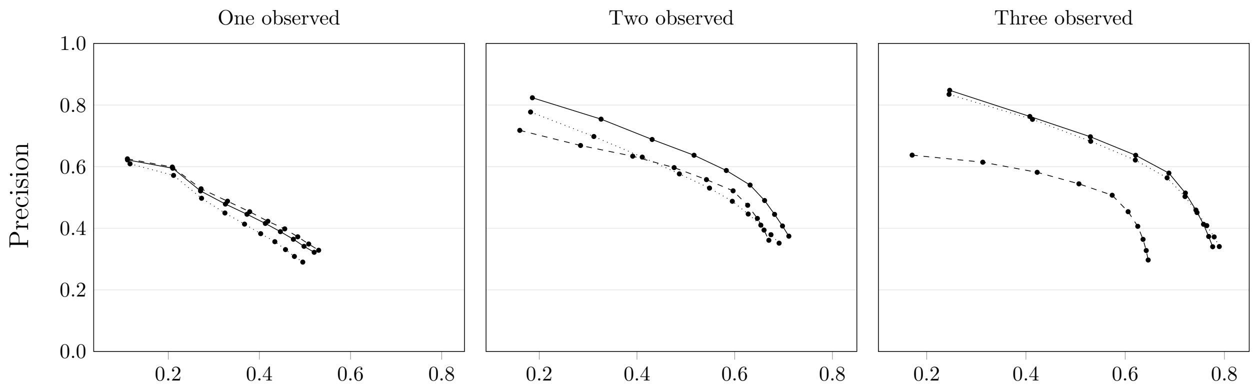

Figure 16: Precision and recall curves for the cylindrical boss features within bodies components – BN (solid), N-Gram (dashed) and ANN (dotted) – calculated at K from 1 to 10. Recall increases as a greater number of suggestions are returned (as k increases).

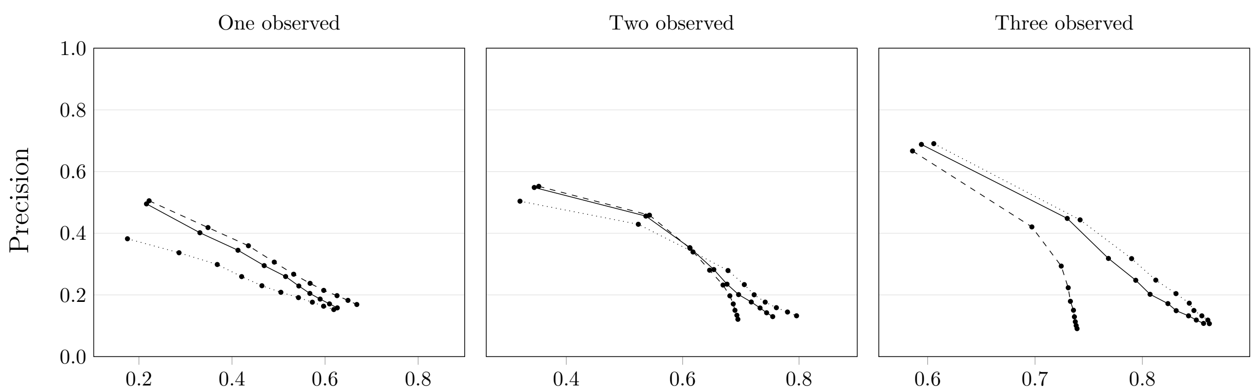

Figure 17: Precision and recall curves for the hole features within bodies components – BN (solid), N-Gram (dashed) and ANN (dotted) – calculated at K from 1 to 10. Recall increases as a greater number of suggestions are returned (as k increases).

S4 Prediction Results from Valve Bonnets

Precision@k and recall@k were calculated for a range of k from one to ten, which were then averaged across the ten folds for the sets of features extracted from 156 valve bonnet designs. The predictive performance of the algorithms are similar to the previous analysis on the valve bodies.

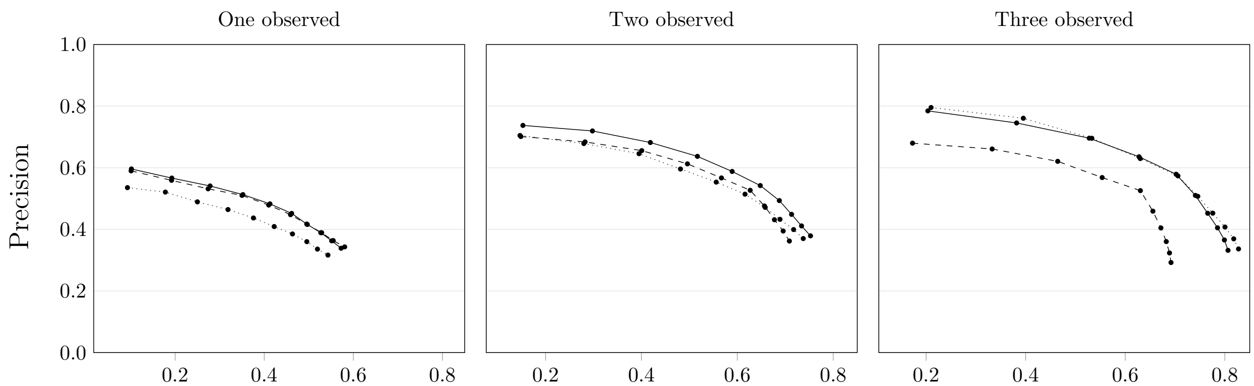

Figure 18: Precision and recall curves for Bonnet components – BN (solid), N-Gram (dashed) and ANN (dotted) – calculated at K from 1 to 10. Recall increases as a greater number of suggestions are returned (as k increases).