**Objectives**

- Support TVG authoring by providing:
  - Automated product bauraum representations
  - Automated time study estimations
  - Support line balancing and change management by providing an intuitive interface for planners to modify balances

1. Develop an integrated Workstation and TVG information model
   - Use existing TVG information model and relate it to a workstation model
   - Support Line Balancing edits using the integrated information model

2. Develop a tool to generate bauraum representations
   - Bauraus are virtually demarcated workspaces. Product bauraum is the final resting location of the part
   - Use CAD data or assembly coordinates to compute product bauraus
   - Write computed information to central database for TVG authoring

3. Extend Bauraum tool to output information for querying MTM charts
   - Use product information and plant layout data to automate querying of MTM tables and therefore reduce possibility of human error

**System Architecture**

1. Bauraum Identification Tool
   - Inputs CAD models of the vehicle; and plant layout
   - Outputs product bauraus and MTM codes
   - Uses product bauraus and other part information to chose an appropriate MTM code

2. TVG Authoring
   - Allows planners to author TVGs using controlled vocabulary

3. Workstation Model
   - Stores and allows users to edit workstation information

4. Line Balancing Tool
   - Takes TVGs and workstation information as input
   - Outputs TVG_assigned_to_station

5. Visualization Tool
   - Inputs TVG_assigned_to_station and creates a visual representation of the entire assembly line
   - Allows planner to modify the balance by moving TVGs around, within the restrictions of the various space and time constraints

**Prototype Tools**

- **Automated Time Estimation**
  Selecting and parsing MTM tables is an error prone process. To reduce the chance of error occurrence, MTM table selection and parsing must be automated. This automation is enabled by information inputs from the Bauraum Identification Tool and structured work instructions.

- **Visualization Tool Implementation**
  The visualization tool has been implemented and a screen shot is shown below. Different colors indicate violation of different constraints.

**Functional Block Diagrams**

- **CAD DATA**
- **PLANT LAYOUT**
- **BAURAUM IDENTIFICATION TOOL**
- **BAURAUM PICTORIAL REPRESENTATION FOR TVG**
- **PART WEIGHT, SURFACE AREA**
- **DISTANCES**
- **AUTO_TMED TIME ESTIMATION**
- **MTM Code(s)**

**Figure 2:** Functional block diagram of Bauraum Identification Tool and Automated Time Estimation Tool

**Prototype Tools**

- **Bauraum Identification Tool**
  The Bauraum Identification Tool has been implemented. The code has been incorporated into SolidWorks through an API. The following are the outputs as obtained from the Bauraum Identification Tool

**Prototype Tools**

- **Visual Tool Implementation**
  The visualization tool has been implemented and a screen shot is shown below. Different colors indicate violation of different constraints.

**Figure 6:** MTM estimate generator

**Figure 7:** Functional prototype of line balance visualization tool