



BRIGHAM YOUNG UNIVERSITY  
AUVSI CAPSTONE TEAM (TEAM 45)

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## UGV Delivery Concept Selection

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ID	Rev.	Date	Description	Author	Checked By
GV-003	1.0	10-31-2018	Created document and decision matrix	Jacob Willis	[CHECKED BY]

# 1 Descriptions

Each of the primary concepts is described in further detail below.

## 1.1 Parachute

A parachute is attached to the UGV, and is opened upon release of the UGV from the aircraft. To improve the accuracy of this concept, the effect of wind on the parachute and payload is characterized and used to calculate the optimal drop location given the estimated wind speed at the time of drop. No control mechanisms are used during the drop.

## 1.2 Parachute with Controls

Similar to the Parachute concept, but control surfaces (fins) are attached to the payload and actuated as the payload drops. This provides some controllability to stabilize the drop and to improve accuracy.

## 1.3 Skycrane

The UGV is lowered on a string or rope while the airframe circles overhead. The circling motion causes the UGV to orbit in a smaller circle as it is lowered. When the UGV hits the ground, it releases itself from the string to prevent interrupting the flight of the airframe. Preferably the UGV controls the rate of descent so it can easily feed back its distance from the ground.

## 1.4 Glider

A glider is carried onboard the airframe and is released when the UGV drop is attempted. The glider either incorporates or carries a ground vehicle. The glider is unpowered, but is controlled like a normal aircraft.

## 1.5 Un-aided drop

The UGV is dropped from the airplane without any mechanisms for slowing its descent. This is used as the reference for the other concepts. Because the competition rules require a gentle landing, an un-aided drop cannot be used as the selected concept.

## 2 Decision

As can be seen from the decision matrix in the below table, the un-aided drop scored highest, while the parachute concept scored second highest. The parachute concept is selected because the un-aided drop will result in disqualification for too hard of an impact. The parachute is the closest concept to unaided drop, but reduces the impact velocity. This concept is described in more detail in GV-006.

*Table 1: A decision matrix for the UGV Drop Method. A scale of 1-5 was used for weights with 5 having high importance and 1 having low importance. A 1-5 scale was also used to rate each option's performance under each requirement. In this case, a 1 was used to indicate poor performance while a 5 indicates favorable performance.*

UGV Drop Method	Weight	Glider	Sky Crane	Parachute	Parachute with controls	Un-aided Drop (Reference)
Drop Mechanism	3	4	2	5	5	5
Mass						
Weight mechanism can support	3	2	5	4	4	5
Aircraft internal volume consumed	4	4	2	3	3	4
Stowed drop mechanism drag	5	1	4	4	4	5
Max landing velocity	4	2	5	4	4	1
UGV landing distance from target	5	2	3	4	5	5
Development complexity	5	1	1	4	2	5
Totals	-	62	89	115	110	125