Project Plan:
Unmanned Air/Ground Vehicle

(UAGV)

IPT 2001

Submitted By:

The University of Alabama in Huntsville

February 1, 2001

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Mechanical Configuration	Alex Maciel, Al Reed
Aerodynamics	John Berry
Propulsion/Drive	Jamie Kimbel; Charles DePlachette
Ground Robotics	Virginia Young;
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Participating Agencies

Army Aviation and Missile Command	Ecole Superieure des Techniques Aeronautiques et de Construction
The University of Alabama in Huntsville	The Boeing Company
Smith Enterprises	SRS Technologies
M-Studio	Teledyne Brown Engineering
NASA MSFC	NASA Ames

Executive Summary

English

This Project Plan outlines the strategy and tactics for the IPT 2001 Project The objective of this effort is to study, analyze and develop multiple conceptual design, which merge robotic techniques and automation technologies into a hybrid UAV/UGV vehicle/system. The effort began in September 2000 with background work performed by four classes at UAH. These classes interacted with customer representatives and mentors to develop a Concept Description Document and to assess related technologies. The current plans include forming three student integrated product teams that will each develop concepts to meet the project objectives. The teams will work together in Phase 1 on a baseline design and technology assessment. In Phase 2, each team will develop four alternative concepts for consideration and selecting one preferred configuration. Phase 3 consists of each team refining and developing a proposal for their selected concept. The student teams are made of senior-level mechanical and aerospace engineering students from the University of Alabama in Huntsville and ESTACA a college in France. Industrial mentors who focus on particular disciplines required for the design will assist the teams. Student support teams will also assist the project in the areas of technical communication, marketing, systems engineering, electrical design, and web page development. An external Review Team will assess team progress at the end of each phase. The final assessment will rank the concepts.

French

Ce rapport trace les grandes lignes pour le projet IPT 2001. Ce projet a pour but d'étudier, d'analyser et de développer un concept regroupant la robotisation et les technologies d'automate à travers un véhicule/système hybride UAV/UGV. Ce projet débuta en septembre 2001 où quatre classes à UAH travaillèrent sur les bases de cette étude. En collaboration avec les clients et les mentors, les étudiants définirent un cahier des charges, document décrivant le concept et évaluant les techniques relatées. Au cours de ce projet, trois équipes seront formées et devront développer un concept répondant aux exigences des clients. Cette étude se décompose en trois phases. Pendant la première étape, les trois équipes travailleront ensemble afin de definir un concept de base et les différentes technologies utilisées. Dans la seconde phase, chaque équipe développera quatre concepts afin de choisir celui qui répond au mieux au cahier des charges. Puis, au cours de la troisième phase, les équipes raffineront le concept selectionné. Les étudiants devront avoir des compétences mécaniques et aérospatiales. Ils seront assistés par des mentors specialisés dans les différentes disciplines que requièrent ce projet. De plus, une équipe de support sera mise en place afin d'aider dans les domaines de la communication, du marketing, du systems engineering et dans la conception d'une page web. A la fin de chaque étape, un jury externe statuera sur le progrès de chaque équipe ainsi que sur les concepts selectionnés.

Table of Contents

Common Terms and Acronyms List ..... **v**
IPT2001 –Project Plan **1**
1.0 Objectives and History **1**
1.1 Project Objectives **1**
1.2 Educational Objectives **1**
1.3 Class History **1**
2.0 IPT2001 Details **3**
2.1 Participants **3**
2.2 Rules of the Competition **4**
2.3 Schedule **4**
2.5 Proposal Requirements **5**
2.6 Basis of Evaluation of Final Proposal **5**
2.7 Baseline Concept Description Document **5**
2.8 Team Structure **5**
2.9 Class Deliverables **6**
3.0 Course Syllabus Information **1**
3.1 Course Schedule **1**
3.2 Basis of Course Grade **2**
References **2**
Appendix A - Concept Description Document **1**

Common Terms and Acronyms List

Word	Comments
AGL	Above Ground Level
AIAA	American Institute of Aeronautics and Astronautics
AMCOM	United States Army Aviation and Missile Command
BLOS	Beyond Line of Sight
CAD	Computer aided design
CM	Communication
Concept Description Document	Document that details the customer's technical specifications for the UA/UGV
CST	Central Standard Time
Customer	John Fulda and Jim Winkeler
Dry Weight	
EE	Electrical Engineering
EH	English
EM	Engineering Management
EST	Editorial Support Team
ESTACA	Ecole Superieure des Techniques Aeronautiques et de Construction
FLOT	Forward Line of Troops
Ft	feet
IPT	Integrated Product Team
IRP	Intermediate Power Rating
JAUGS	TBD
JCDL	TBD
Joint Vision 2020	TBD
km	Kilometer
lbs.	pounds
MAE	Mechanical and Aerospace Engineering
MKT	Marketing
MSFC	Marshall Space Flight Center
MULE	Modular Unmanned Logistics Express
MULE	Modular Unmanned Logistics Express
NASA	National Aeronautics and Space Administration
nm	Nautical miles (~2025 yds)
Payload	Item carried by the system having a specified weight
Phase 1	Baseline review, conducted on conventional configuration using current and experimental technology, assess technologies clarify the Concept Description Document
Phase 2	Alternative concepts review, development and evaluation of four prototype designs to meet customer specifications. Select a preferred design.
Phase 3	Final Evaluation, detailed design specifications of

	selected design concept
RFP	Request for Proposal
RMA	Revolution of Military Affairs
Style Guide	Document that specifies the mechanics of writing documents required for the project
TBD	To be determined (not know at this time)
TBE	Teledyne Brown Engineering
TF/TA	Terrain following/terrain avoidance
UAH	The University of Alabama in Huntsville
UAV	Unmanned Air Vehicle
UGV	Unmanned Ground Vehicle
US	United States
VROC	Vertical rate of climb
VTOL	Vertical takeoff and landing

IPT2001 –Project Plan

1.0 Objectives and History

1.1 Project Objectives

Missile and aviation systems must increase use of emerging and advanced technologies in order to remain viable in the complex battlefield environments of the future. The Chief of Staff of the Army vision and of the Joint Vision 2020 stresses the increased reliance on "intelligent" systems and components, which enhance the Revolution of Military Affairs. This RMA criterion increases the emphasis on robotic qualities of future weapons systems/subsystems and related manufacturing techniques. These consequently support evolving technologies providing dominance on the battlefield of tomorrow.

The objective of this effort is to study, analyze, and develop multiple conceptual designs, which merge robotic techniques and automation technologies into a hybrid UAV/UGV vehicle/system. Use of existing and evolving manufacturing tools and materials will be stressed to assist in defining these technologies that are available/applicable in the near and far terms, and will permit the inevitable marriage of the UAH with UGV. Use of various software technologies (expert systems and artificial intelligence methodologies), simulation techniques, CAD and advanced manufacturing capabilities will be applied in defining the UAV/UGV concept.

1.2 Educational Objectives

In high-technology business, companies are using multi-disciplinary teams. Decreasing product costs and reducing time to market demands that specialist from diverse backgrounds learn how to work interactively under a set of system-level requirements. Top companies must be able to put together products in conjunction with domestic and international business partners using advanced technologies in a dynamic political/economic environment.

To excel in this environment, our students must enter the work force with

? The character to function responsibly in a team setting,
? The communication skills to express oral, written, and advance audio-visual media,
? The critical thinking skills to identify the crucial issues from all disciplines that are required to approach an open-ended project, and
? A design education that serves as the basis of lifelong learning

A Company can typically spend one to three years orienting a new hire to function effectively in a team. UAH has established a project course that will orient its students to these important issues before they graduate. This gives UAH students and their future employers a tangible advantage in initial productivity and increases the likelihood of employee success over their career.

1.3 Class History

Over the past eight years, UAH has experimented with Integrated Product Teams [Frederick 1996] to perform system level concept studies. The projects have included a hybrid sounding rocket [Paxton 1993], a tactical missile system, a magnetic levitation train, a hybrid rocket

upper stage[LaSarge 1996], a rocket-powered glider, an autonomous rotorcraft, a Heavy Lift Helicopter [Hopper 1999], and a Crew Transport/Recovery Vehicle or the International Space Station [Thomas 2000]. A key component of this effort has been the participation of mentors, technical professional from outside the university, who assist the students in learning about specialty topics. The missile system design team received First Place in the AIAA National Team Missile Design Competition in September 1994.

The approach has progressed from a single engineering class in 1992 to a project involving three UAH colleges, a French college, an Alabama High School, and several local businesses. A key aspect of the approach has been the integration of students and faculty from different disciplines and the use of mentors to assist the student teams. Industry professionals have volunteered to mentor students. The volunteers have devoted hundreds of hours to assist the students in the development of their professional skills in these projects.

The 1999 project involved several agencies led by the UAH College of Engineering. The U.S. Army Aviation and Missile Command helped the students with some technical advice. Engineers from the Boeing Company volunteered their personal free time to mentor the students in process/technical Systems Engineering. Allison Advanced Development, SRS Technologies, ADTRAN, M-Studio, and Rapid Tech Engineering participated in this year's project. Stone Engineering oversaw a Review Team to monitor the progress of the student teams. Within the University Community, we had the UAH College of Engineering, and the UAH College of Liberal Arts [Norman 1999]. ESTACA, an undergraduate Engineering College in France, participated via the Internet.

The participants for the 2000 IPT Crew Transfer/Recovery Vehicle System were the UAH College of Engineering and ESTACA, an Engineering college in France. The French were partners that participate in Integrated Product Teams (IPTs) that competed in this project. Snecma, a propulsion company in France, and NASA Marshall Space Flight Center, provided technical advise to IPT members.. M-Studio of Huntsville produced concept drawings of the concepts. Linden High School visited UAH to learn about Space Transportation at a special Open House. Boeing in Huntsville, Alabama served as our customer by establishing the Concept Description Document.

Information about the current past classes can be obtained at the following Internet sites:

http://www.eb.uah.edu/ipt2001/	2001 Air/Ground Robotics
http://www.eb.uah.edu/ipt/ipt2000/	2000 Crew Transport Recovery Vehicle
http://www.eb.uah.edu/ipt1999	1999 Advanced Prop. Rotorcraft
http://eb-p5.eb.uah.edu/ipt/	1998 MULE Project
http://smaplab.ri.uah.edu/iptclass/index.html	1997 Rocket Glider Project
http://eb-p5.eb.uah.edu/rocket/	1996 Upper Stage Rocket Project
http://eb-p5.eb.uah.edu/maglev/studentr.html	1995 Mag Lev Train Project

2.0 IPT2001 Details

2.1 Participants

The project participants come from university, industry and the government. The university participants are:

? The UAH College of Engineering, Department of Mechanical and Aerospace Engineering
  MAE 464 Aerospace Design - Robert Frederick
  MAE 465 Mechanical Engineering Design – Robert Frederick
  MAE459-01 Air-Ground Robotics Technology – Robert Frederick (Fall 2000)
  MAE 659-01 Air-Ground Robotics Technology – Robert Frederick (Fall 2000)
  MAE 497 Aerospace Engineering Senior Project – Robert Frederick (Fall 2000)
? The UAH College of Engineering, Department of Industrial and Systems Engineering
  EM 679 Project Management in Action – Dawn Utley
  ISE 627 – Introduction to Systems Engineering – Paul Componation (Fall 200)
? The UAH College of Engineering, Department of Electrical and Computer Engineering
  CPE 437 - Computer Engineering Design II - Earl Wells
? The UAH College of Liberal Arts, Department of English
  CM/EH 302 Technical Editing – Rose Norman
  EH 502 Problems in Technical Writing
  EH 649 Web Design - Rose Norman
? The UAH College of Administrative Sciences, Marketing Department
  MKT 414 – Marketing Emerging Technologies – David Berkowitz
? The UAH College of Engineering, Department of Electrical and Computer Engineering
  EE 494 – EE Design Projects– Charles Corsetti
? Ecole Superieure des Techniques Aeronautiques et de Construction Automobile
  12-fourth year students

The participating government agencies and industries are:

? The U.S. Army Aviation and Missile Command, Advanced Systems Concept Directorate
? The Boeing Company
? M-Studio
? Smith Enterprises
? NASA MSFC Science Directorate
? Teledyne Brown Engineering
? Coleman Research
? CAS Inc

2.2 Rules of the Competition
The project will be operated in a competitive fashion among the three integrated product teams. The following are the rules of the competition.

1. All undergraduate and graduate UAH/ESTACA IPT members are eligible and encouraged to participate.

2. ***Seven copies*** of the design will be submitted; each must bear the signatures, names of the project leader and the Student Members who are participating. Designs that are submitted must be the work of the students, but guidance may come from the Faculty Advisor and Mentors and should be accurately referenced and acknowledged.

3. Certificates will be presented to the all participants with special recognition top the winning team. One representative from the first place design team will be expected to present a summary design paper at the 2001 AIAA Joint Propulsion Conference in Salt Lake City Utah. Members of the winning team will be invited to France to a technical symposium on the project at ESTACA. Partial support for the travel is anticipated.

4. The Final Proposal should be ***no more than 50 double-spaced typewritten pages and the style is specified in a Style Guide. Each team will present a 30-minute oral briefing to a Review Team and answer questions for a period not to exceed 15 minutes***

2.3 Schedule
Significant activities, dates and addresses for submission of proposal and related materials are as follows. Please refer to the IPT Course Syllabus for more specifics.

A. Letter of Intent	**15 January, 2001; 12:00 Noon CST P.M. Electronic Delivery**
B. Baseline Documentation	**31 January, 2001; 11:00 PM CST; Electronic**
C. Baseline Presentation	**1 February, 2001; 5:40 PM CST; Filmed**
D. White Paper	**28 February, 2001; 11:00 PM CST; Electronic**
E. Alternative Concepts Review	**1 March, 2001; 3:55-5:15 PM CST, Oral**
F. IPT 2001 Open House	**1 March, 2001 5:15 – 7:00 PM**
G. Receipt of Final Proposal	**23 April 2001; 11:00 PM CST, Electronic**
H. Oral Presentation	**28 April, 2001; 3:00–5:30 CST**
I. Awards Banquet	**29 April, 2001 11:00 – 1:00, TBD**

Individuals intending to submit a proposal must electronically submit a letter of intent, with a maximum length of one page and one resume of each IPT member or before the date specified above, at the WebCT Bulletin Board. (http://classweb.eb.uah.edu).

The finished proposal must be electronically submitted (postmarked) to frederic@eb.uah.edu, on or before the date specified for the Receipt of Proposal. Late submission is grounds for disqualification for the competition.

2.5 Proposal Requirements

The technical proposal is the most important factor in the award of a contract. It should be specific and complete. While it is realized that all of the technical factors cannot be included in advance, the following should be included and keyed accordingly:

1. Demonstrate a thorough understanding of the Concept Description Document (CDD) requirements.
2. Describe the proposed technical approaches to comply with each of the requirements specified in the CDD, including phasing of tasks. Legibility, clarity, and completeness of the technical approach are primary factors in evaluation of the proposals.
3. Particular emphasis should be directed at identification of critical, technical problem areas. Descriptions, sketches, drawings, systems analysis, method of attack, and discussions of new techniques should be presented in sufficient detail to permit engineering evaluation of the proposal. Exceptions to proposed technical requirements should be identified and explained.
4. Include tradeoff studies performed to arrive at the final design.
5. Provide a description of automated design tools used to develop the design.

2.6 Basis of Evaluation of Final Proposal

1. Technical Content (35 points) This concerns the correctness of theory, validity of reasoning used, apparent understanding and grasp of the subject, etc. Are all major factors considered and a reasonably accurate evaluation of these factors presented?

2. Organization and Presentation (20 points) The description of the design as an instrument of communication is a strong factor on judging. Organization of written design, clarity, and inclusion of pertinent information are major factors.

3. Originality (20 points) The design proposal should avoid standard textbook information, and should show the independence of thinking or a fresh approach to the project. Does the method and treatment of the problem show imagination? Does the method show an adaptation or creation of automated design tools.

4. Practical Application and Feasibility (25 points) The proposal should present conclusions or recommendations that are feasible and practical, and not merely lead the evaluators into further difficult or insolvable problems.

2.7 Baseline Concept Description Document

The Baseline Concept Description Document is presented in Appendix A. During Phase 1, Teams will be able to dialogue with the customer about the specifications and make recommendations for changes in the requirements. The teams must make a formal presentation for recommended changes to the specification to the customer at the Baseline Review. The customer will accept or reject these changes by February 5, 2000. At this point the CDD will not be changed without the written approval of the customer, the Project Director, and all three IPT Team leaders.

2.8 Team Structure

The class will operate in integrated project teams. Each team consists of the MAE 464, MAE 465 and ESTACA engineers who will work together to produce a final proposal. In an

integrated product team, each member has specific technical and administrative responsibilities. Working together, the team integrates the various ideas and constrains from each discipline together to meet the overall project specifications.

The first item for each student will be to secure a position on a team in a specific discipline. The following is a short description of the disciplines and the initial scope of their responsibility.

2.9 Class Deliverables

1) Baseline Review: Thursday February 1, 2000, 3:55 – 5:15, UAH EB 122

- One 45-minute vugraph presentation by one student team covering the Concept Description Document, a first-order technology assessment, and a baseline design using existing technology
- Question and Answer period by Review Team - 20 minutes

2) Alternative Concepts Review, Thursday March 9, 2000; 3:55 – 5:15, UAH EB 123

- Open House from 5:15 – 7:00 PM
- Three 15-minute Poster Presentations by three teams.
- Three 10-minute question and answer periods by Review team
- 15-page White Paper Delivered by Each Team

3) Final Proposal Review, Thursday April 27, 2000; 3:00 – 5:30 PM, UAH EB 122

- Three 30-minute presentations, 15-minute question and answer
- Three 50-page proposals provided April 24, 200 to Review Team

Table 1 - Disciplines and Mentors

Discipline	**Scope**	**Mentors**
Project Office	Customer Interface, Payload Requirement's, ESTACA Interface, Team Deliverables, Team Member Evaluations	John Fulda [AMCOM], Jim Winkeler [AMCOM], Sheri Adlich [TBE], Robert Frederick [UAH]
Programatics and Marketing	25-Year Schedule, Life Cycle Costs, Marketability	Pat McInnis [AMCOM], Jim Sanders [NASA Retired], David Berkowitz [UAH]
Systems Integration	Ground Rules/Assumptions, Configuration Synthesis, Design Process, System Performance	Jim Dinges [AMCOM], George R. Smith [Smith Enterprises]
Aerodynamics	Levitation, Airfoil Design, Power Requirements	John Berry [AMCOM]
Propulsion/ Drive	Flight Power, Ground Power, Energy Sources	Jamie Kimble [AMCOM], Charles DePlachett [SRS Technologies]
Mechanical Configuration/ Documentation	Mass Properties, 3-view drawings, Structures/Thermal, Technical Reporting	Mechanical Configuration – Alex Maciel [M-Studio], Technical Reporting - Rose Norman [UAH], and Al Reed [AMCOM]
Ground Robotics	Mobility Package, External Control, Advanced, automation technologies	Virginia (Suzi) Young [AMCOM], John Piccirillo [UAH]
Acoustics/ Controls	Noise Suppression/ Control System Architecture	ESTACA TBD, Kader Frendi [UAH]
Sensors/ Communications	Sensors, Communications, Software	Alan Gamble [AMCOM], Bruce Lewis (Possible) [AMCOM], Charles Corsetti

The students and mentors in each discipline forma a discipline team. Each discipline team will have a student point of contact, a primary mentor, and a weekly standing meeting time and place. A collection of the discipline teams is called an Integrated Product Team. Figure 4 shows the relationships among the mentors, IPTs and Discipline Teams

IPT 2001 - Discipline Matrix

IPT3	IPT2	IPT1	Mentors	Scope	Discipline
Nathan Smith	Melanie Janetka	Laura Filz	John Fulda [AMCOM], Jim Winkeler [AMCOM], Sheri Adlich [TBE], Robert Frederick [UAH]	Customer Interface, Payload Requirement' s, ESTACA Interface, Team Deliverables, Team Member Evaluations	Project Office
Matt Harris	Demetrius Peoples	Richie Sparkman	Pat McInnis [AMCOM], Jim Sanders [NASA Retired]	25-Year Schedule, Life Cycle Costs, Marketability	Programatics
James Kodrowski	Ben Bramblett	Kris McDougal	Jim Dinges [AMCOM], George R. Smith [Smith Enterprises], David Berkowitz [UAH]	Ground Rules/Assumptions, Configuration Synthesis, Design Process, System Performance	Systems Integration
Akmal Abdulakhato	Chris Hirsten	Kevin Buch	John Berry [AMCOM]	Levitation, Airfoil Design, Power Requirements	Aerodynamics
Jason Back	Shane Lacky Tim Weaver	Tim Hardin Shane Canevday	Jamie Kimble [AMCOM], Charles DePlachett [SRS Technologies]	Flight Power, Ground Power, Energy Sources	Propulsion/ Drive
Sheree Long Kannathas Krishnasamy	Jon Kilpatrick Damon Hay	Timor Hakimov	Mechanical Configuration – Alex Maciel [M-Studio],	Mass Properties, 3-view drawings, Structures/Thermal, Technical Reporting	Mechanical Configuration/Documentation
T.B.D.	T.B.D.	Virgil White			Technical Reporting - Rose Norman [UAH], and Al Reed [AMCOM]
Bryan Grffin	Rajat Sharma	Jason Newton	Virginia (Suzi) Young {AMCOM], John Piccirillo [UAH]	Mobility Package, External Control, Advanced, automation technologies	Ground Robotics
J. Geffard F-X Hussenet	Estaca	Estaca	ESTACA TBD	Noise Suppression/ Control System Architecture	Acoustics/ Controls
Pascal Vidal		Angelene Nuar	Alan Gamble [AMCOM], Bruce Lewis (Possible) [AMCOM], Charles Corsetti	Sensors, Communications, Software	Sensors/ Communications
					MEETING TIME/PLACE

Figure 1 – IPT/Discipline Team Structure

3.0 Course Syllabus Information

3.1 Course Schedule

Figure 3 below shoes the outline of scheduled class activities.

Period	Date	Major Activity
1	January 9, 2001	Overview
2	January 11, 2001	Discipline Assignments
3	January 16, 2001	Groundrules
4	January 18, 2001	Aerodynamics/Ground
5	January 23, 2001	Engine/Communications
6	January 25, 2001	Configuration Review
7	January 29, 2001	Dry Run Presentation
8	**February 1, 2001**	**Baseline Review**
9	February 6, 2001	Assessment
10	February 8, 2001	Team Meetings
11	February 13, 2001	Team Meetings
12	February 15, 2001	Team Meetings
13	February 20, 2001	Team Meetings
14	February 22, 2001	Team Meetings
15	February 27, 2001	Dry Run Presentation
16	**March 1, 2001**	**Alternatives Review**
17	March 6, 2001	Assessment
18	March 8, 2001	Team Meetings
19	March 13, 2001	Team Meetings
20	March 15, 2001	Team Meetings
21	March 20, 2001	Team Meetings
22	March 22, 2001	Progress Briefing
23		UAH Spring Break
24	April 3, 2001	Team Meetings
25	April 5, 2001	Team Meetings
26	April 10, 2001	Team Meetings
27	April 12, 2001	Final Report Draft
28	April 17, 2001	Team Meetings
29	April 19, 2001	Team Meetings
30	**April 26, 2001**	**Final Review (3:00 - 5:30)**

Figure 2– Class Period Activities

3.2 Basis of Course Grade

The Course grade is determines by the following formula:

Personnel Review	20%
Baseline Review	15%
Alternatives Review	20%
Final Review	25%
Final Examination	20%

References

Frederick ,R.A., Jr., Evans, D.A., and Norman, R.L., "Multi-Agency, Integrated Product Teams Stanley L. Proctor, ABET President Elect, Innovations in Engineering Education, Accreditation Board for Engineering and Technology (ABET) 1996 Annual Meeting, San Diego, CA; October 31 to November 1, 1996.

Hopper, M., Davis, K., Symes, A., and Frederick, R.A., Jr., "Preliminary Design of Rotorcraft with Multi-Disciplinary, International Teams," AIAA Paper No. 99-2845, 35th AIAA/ASME/SAE/ASEE Joint Propulsion Conference Joint Propulsion Conference, Los Angeles, CA, June 20-23, 1999.

LaSarge, P.A., Ford, S.I., and Frederick, R.A., "Conceptual Design of Hybrid Rocket Powered Upper Stage (HRPUS) Demonstrator," 32nd AIAA/ASME/ASEE Joint Propulsion Conference and Exhibit, Lake Bunea Vista, FL, AIAA Paper No. 96-2841, July , 1996.

Norman, R., and Frederick, R.A., Jr., "Integrating Technical Editing Students in a Multidisciplinary Engineering project," Conference on College Composition and Communication, Atlanta, GA, March 24-27, 1999.

Paxton, J., Achenbach, Patterson, P., M. Pyburn, J., Thomas, M., and Frederick, R. A., Jr., "Design of Turbopump-Fed Hybrid Launch Vehicle," AIAA 93-2549, AIAA/SAE/ASME/ASEE 29th Joint Propulsion Conference and Exhibit, Monterey, CA, June 28-30, 1993.

Thomas, S., Bollich, J., Popo, M. and Robert Frederick, Jr.. "Concepts for an ISS Crew Transfer/Recovery Vehicle," AIAA Paper, June 2000.

Concept Description Document Approval

The undersigned agree that the attached Concept Description Document as marked will be the basis the UAH IPT 2001 Design Competition. From this time forward, any questions or clarifications concerning the concept description document to the Customer shall be submitted in writing and the answer distributed to all UAH IPT's in writing.

To change the Concept Description Document Prior to April 30, 2001 shall require that the change be stated in writing and that a person authorized by every one of the signers below endorse the change with their signature. The revision will be labeled uniquely and distributed to all teams simultaneously.

The original of this document will be kept on file with the UAH Project Director. All signers will receive a copy of the original document.

_____/_____
John Fulda, Customer

_____/_____
James Winkeler, Customer

_____/_____
Laura Filz, UAH IPT 01

_____/_____
Melanie Janetka, UAH IPT 02

_____/_____
Nathan Smith, UAH IPT 03

_____/_____
Robert A. Frederick, Jr., UAH IPT2001 Project Director

Concept Description Document

for
Integrated Unmanned Air/Ground Vehicle

Final

1. General Description of Operational Capability
   1.1. Overall Mission Area
      1.1.1. The system shall be a versatile scout and pack animal for future force structures.
      1.1.2. The system shall be capable for use for area/target reconnoitering.
      1.1.3. The system shall be capable for use in terrain definition.
      1.1.4. The system shall be capable for use in situational awareness.
      1.1.5. The system shall be capable of both autonomous and semi-autonomous operation.
         1.1.5.1. The system shall be capable of human interface as required.
      1.1.6. The system shall be capable of executing both a preplanned and an alter mission profile.
      1.1.7. The system shall be capable of navigating and functioning without a payload.
   1.2. Operational Concept
      1.2.1. The system shall be capable of operation in a nap of the earth configuration.
      1.2.2. The system shall be capable of operation at a range of 15-30 km from the launch point.
         1.2.2.1. The system shall be capable of gathering information on threat activities at range.
         1.2.2.2. The system shall be capable of enhancing the RSTA/BDA.
         1.2.2.3. The system shall be capable of transmitting information via secure data links and C2 structures BLOS.
         1.2.2.4. The system shall be capable of using TF/TA hardware and software to define and navigate complex terrain.
         1.2.2.5. The system may encompass a degree of AI, ATR, and on-board decision making.
      1.2.3. Payload Requirements
         1.2.3.1. The system shall be capable of carrying a payload of 60lbs required gross weight, 120lbs desired gross weight.
         1.2.3.2. The system shall be capable of moving the payload to operational range in 30 minutes or less and be able to return from range in 30 minutes or less.
            1.2.3.2.1. The vehicle will have a minimum cruise speed of 30 km/hr and a desired speed of 100 km/hr.
      1.2.4. Mission Requirements
         1.2.4.1. The system shall be capable of landing in an unprepared area
            1.2.4.1.1. The vehicle must have vertical takeoff and landing capabilities.
         1.2.4.3. The system shall maximize survivability.
            1.2.4.3.1. The system shall be capable of avoiding sonic detection.

1.2.4.3.2. The system shall have a near quiet acoustic signature.
1.2.4.3.3. The system shall be designed for an operational altitude of 0 – 500 ft AGL.
1.2.4.3.4. The system must have a 250 fpm VROC, 500 fpm desired.
1.2.4.4. The system must have a flight profile of hover to full flight.

2. System Capabilities
2.1. The system shall be capable of operation at an altitude of 4000ft, 95 degrees Fahrenheit ambient temperature, and not using more than 95% intermediate rated power (IRP).
2.2. Operational Performance
2.2.1. The system shall possess essential performance, maintenance, and physical characteristics required to operate under adverse environmental conditions worldwide.
2.2.2 The system shall possess essential performance, maintenance, and physical characteristics required to operate under adverse geographical conditions worldwide.
2.2.3. The system shall be capable of operating from any unimproved land or sea borne facility surface day or night, including low illumination.
2.2.4. The system shall be capable of operation under battlefield obscurants.
2.3.The system shall possess the following electronic capabilities:
2.3.1. Mission Planning System
2.3.1.1. The system shall possess a point-and-click pre-mission planning system to simulate mission flight.
2.3.1.2. The system shall possess data loading capabilities.
2.3.1.3. The system shall be capable of coordination and reaction to immediate operational mission changes.
2.3.1.4. The system shall be capable of processing self awareness and threat sensor inputs.
2.3.1.5. The system shall be capable of enabling TF/TA from digital mapping information from satellite or other sources.
2.3.2. Avionics
2.3.2.1. Communications and navigation suite architecture shall be compatible with emerging JCDL and/or JAUGS.
2.3.2.2. Payload must be “plug and play.”
2.3.3. Communications
2.3.3.1. System communications shall be robust and have clear secure modes of operation
2.3.3.2. Communications shall be simultaneously LOS and BLOS which can include satellite relay or other relay system compatibility.
2.3.3.3. System must posses IFF and be compliant to all FCC/military communication regulations.
2.3.3.4. System must be capable of communication with and sharing digital mapping/targeting information with other DoD RSTA platforms.
2.3.4. Connectivity

2.3.4.1. The system shall be interoperable with other DoD systems envisioned for the 2025 battlefield to the maximum extent possible and be compatible with service unique C41 systems.