SPECIAL TECHNICAL REPORT
FOR
LABORATORY-TO-FIELD TRANSITION OF THE POLICY ANALYSIS MARKET

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SUMMARY OF PAM TRANSITION EFFORT

The security of the United States emerges from interconnected developments within and among nations. The goal of proactive policy analysis is to ascertain what connections will impact U.S. security and in what ways U.S. actions influence those connections. The Policy Analysis Market (PAM) has been designed by Net Exchange as a prototype decision support tool for the U.S. security establishment. Two guiding concepts motivate the design of PAM: (i) Futures markets focus diffusely held insight into valuable predictions (prices). And (ii) the interconnectedness of the information underlying the intended application of PAM requires a market mechanism that transacts composites of assets that are believed to be correlated by the traders who request the transactions. These two concepts are embodied in the description of PAM as a combinatorial information market.

The Defense Advanced Projects Research Agency (DARPA) has funded Net Exchange to mature the PAM concept to the point of a prototyping field test. The most recent, and just concluded, phase of this funding was meant to facilitate three key design decisions for a prototype PAM; (i) the specific form of market mechanism, (ii) the availability of data upon which to define PAM assets and the process to provide these data, and (iii) the type of user interface and user experience that would be appropriate for PAM. In summary; (i) a combinatorial market maker has been chosen as the sole market mechanism for the initial PAM prototype, (ii) The Economist Intelligence Unit has identified appropriate data sources and a process to develop and maintain assets based on these, and (iii) a map-based interface will be employed.

The principal intent of this report is to provide the technical background information that justifies the design decisions that have been made during the just-concluded effort. In addition, a field-test implementation plan for a PAM prototype has been developed and will be described. The implementation features four months of development overlapped with four months of participant marketing and training – resulting in live PAM trading six months after DARPA commits to the field-test effort.

Most of the information in this report is supplied in the form of appendices, which will be briefly reviewed in the body text that follows. Appendix A provides background information on the basic PAM concepts and the intent of this transition effort while Appendix B is a presentation of the work that justifies the design decisions. Appendices C, D, E, and F cover the work accomplished in greater detail.

MARKET MECHANISMS

Two combinatorial market mechanisms were examined for use in PAM; a combined value call market (CVC) and an automated combinatorial market maker (MM). Though both allow for composite asset trading, they differ fundamentally in order matching technique, deployed history, and order format.

In a market based on CVC, orders are submitted and accumulate until the market is called. Trades are identified through a process of multilateral order matching – participants are direct counter-parties with each other. Several commercial implementations of CVC-based markets have been deployed, starting in the early 1990s. The CVC mechanism was not specifically designed for use in an information market; however, Net Exchange determined that it could be modified for such use.

In a market based on MM, all trades are matched by a software intermediary, the market maker – a trader is never the direct counter-party to another trader. MM trades subject to fixed reaction functions and would require a small and bounded amount of subsidization from the PAM operator. The MM was specifically designed for an information market application like PAM; however, it has never been deployed nor extensively tested. The mechanics of the MM are described in Appendix F.

It is considered reasonable that PAM could eventually use a mix of these two mechanisms. However, the goal of the transition phase was to determine which of the two would be the best choice for the initial PAM prototype deployment. To make this choice, the mechanisms had to be configured so that a common order format and trading interface could be used to test them. Further, the comparison tests needed to be based on a known, controlled, and relatively simple environment. Appendices B and C describe the configuration of these two mechanisms for PAM testing and the tests that were conducted.

The data from these mechanism tests is described in Appendix D and the design decision for the initial prototype is described in Appendix B. The tests confirmed that combinatorial mechanisms are the proper choice for PAM-like information environments. Further, MM performed marginally better to substantially better than CVC, depending on the specific test run. Several design improvements have been suggested from the testing experience for both MM and CVC, and many of these should be pursued during the PAM prototyping effort, but the design decision for the initial prototype deployment is clear – PAM will initially deploy in an MM-only architecture.

DATA SERIES AND ASSET PROCESS DEVELOPMENT

The Economist Intelligence Unit (EIU) has completed the task if identifying data series that can be used to construct PAM assets. The EIU has also completed the initial design of a process to collect, maintain, and judge the payoff values of these assets. Appendix E describes the EIU's effort in support of PAM.

In brief overview, data availability was examined for the 24 countries that constitute the PAM target region (the Middle East, Subcontinent, Central Asia, and the Caucuses) with the intent of ascertaining whether the following five PAM assets could be constructed per country: Economic Health, Civil Stability, Military Posture, Economic Involvement with the U.S., and Military Involvement with the U.S. The EIU concluded that these five could be supported for most of the 24 countries (the exceptions are noted in Appendix E). Additionally, assets dealing with U.S. and global economic health are easily available

and will be available in PAM so that connections between the PAM region and the U.S. and/or global events can be predicted.

Looking forward, the EIU has agreed, in principle, to collect quarterly data and process these into asset indices, serve as judge of the quarterly level of each asset, and maintain and operate a transparent process supervised by an advisory panel. Included in the quarterly data for a PAM prototype would be four quarters of historical data to help PAM traders become familiar with nature of the assets.

PRODUCTION USER INTERFACE DESIGN

The user interface for the production prototype of PAM will be map-based. Information regarding assets for a PAM nation will be displayed on, and/or will be accessed from, the location of that nation on a map of the PAM region. An off-map box will be placed in the Indian Ocean section of the map for U.S. and global assets.

The market mechanism experiments provided a good test of basic user tools and information feedback techniques. This experience has suggested several order and portfolio analysis tools that will be included in the prototype PAM. These will be accessed by the trader through data tabs along the frame of the PAM map and through pop-us displays activated from each PAM nation.

FIELD TEST IMPLEMENTATION PLAN

The PAM field test implementation plan has four main components: (i) the overall product approach, (ii) technical and operational plans, (iii) the scope, acquisition, and training of participants, and (iv) important roles that can be played by DARPA and potential customers of PAM in the U.S. government.

PAM will be built and deployed as a prototype-in-test. Version 1.0 will be deployed six months after the start of funding and will be of modest scope with a minimal feature set. Each quarter, a revised and enhanced version of PAM will be released. As a prototype-in-test, it will be important to mount a continuing development process that will focus on mechanism and usability improvements and that will use operational trading data and user feedback as a primary source of direction.

The PAM server will be operated 24/7 and will be hosted remotely by a profession provider of such hosting services. The user application will be a Java Applet. When it debuts, PAM will be scoped to support 1,000 users, with a quick ramp up designed for a 10,000-user system and a known means of implementing a 50,000-user system.

Due to concerns for transferring funds between U.S. government agencies and between such agencies and private entities, PAM participation will be limited to non-U.S. government entities. Universities, research institutes, press organizations, and firms likely to be interested and informed about policy matters in the PAM region (insurers, banks) will be given the opportunity to sponsor participants. Individuals who have substantial personal wealth and/or expert background in the PAM-related policy concerns will be able to register directly as participants. Thus, U.S. government personnel may become direct PAM participants. Unless otherwise directed by the U.S. government, Net Exchange will not place any nationality restrictions on whom may be a PAM participant or on what organizations may sponsor a PAM participant.

A marketing effort directed to attract participants to PAM will begin two months after funding begins for the prototype. Interested and well-positioned individuals in universities, research institutes, press organizations, and government agencies will be informed about PAM and asked to *spread the word*. Selective use of press articles and symposia will also be used, including web-forums that cover topics intersecting PAM. Sign up as a PAM participant will be wholly web-based, including the deposit of funds in the registered participant's PAM escrow account.

Participant training will begin four months after the start of funding using a beta of PAM version 1.0. Training will be wholly web-based, though a limited dial-up user support service will be provided by Net Exchange as will an e-mail help utility.

U.S. government sanction for PAM will be needed to cover the liability concerns of Net Exchange and its subcontractors. To avoid the risk of being accused of illegally operating a securities exchange or a gambling system, PAM should be designated as an experimental decision support tool in support of research into improving U.S. national

security. This will make the PAM user agreement much easier to construct and should allow Net Exchange to consider and accept a very broad range of participants.

It would be of substantial help if DARPA could facilitate marketing. Hosting of symposia associated with the FutureMap effort, of which PAM will be a part, would be helpful. Advertising PAM within the DOD and various other government agencies should help to attract participants from a valued demographic. Further along that line of access, a PAM Review Panel could be constituted by representatives of candidate customers within the U.S. government – organizations that might like to own/buy PAM should the prototype prove useful.

PAM will be subject to external audit and Net Exchange will make all necessary records available and cooperate fully with any designated auditor; however, Net Exchange would not pay for any such audit. Net Exchange suggests that the PAM Review Panel take on the role of designating and paying for an auditor for period reviews of PAM accounting.

CONCLUSION

The PAM design is ready to be scaled up to prototype operations. All key enabling technologies and techniques have been identified and tested in a PAM-appropriate fashion. Substantial software coding needs to be done to produce the interface and several portfolio analysis tools; however, these are well understood technologies that need only be applied to PAM – matters solvable with money and time and not needing enabling design decisions. Similarly, scaling the system architecture is a tractable problem not in need of key enabling R&D.