

Serious Analytical Gaming

The 360° Game for Multidimensional Analysis of Complex Problems

Ryan Henry, Steven Berner, David A. Shlapak

Key Findings

- A 360° Game, which fits within the larger family of serious analytical games, is designed to assist in characterizing, analyzing, and responding to complex, multifaceted problems in the quickest and most comprehensible way.
- A 360° Game assembles a cross-section of stakeholders, subject-matter experts, and hands-on operators to interactively investigate a problem from an encompassing set of perspectives and approaches.
- The design is objective-driven to reveal solutions to a given target problem. It employs exploratory analysis to provide insights and learning experiences, but not decision-level answers.
- The 360° Game is best suited for situations in which the sponsor is dissatisfied with, or uncertain about, already proposed solutions. It may also be useful when other analytical approaches have proven insufficient.
- It is played in a single, full day at a dedicated venue, moving between plenary and breakout activities. Players are divided into interdisciplinary cells in which they brainstorm, discuss, assess, and report candidate solutions for their slice of the bigger problem, which is given to them in the form of a multimedia scenario/alternative future.

SUMMARY ■ The 360° Game was created to help the Defense Advanced Research Projects Agency (DARPA) address one of its enduring challenges: technology transfer. It has also been successfully applied in developing an overarching cybersecurity framework for the Hewlett Foundation. This report is designed to facilitate an understanding of the 360° Game's capabilities, utility, and efficacy for researchers, project leaders, and sponsors. It provides background on the game, as well as guidelines for scoping, developing, and running a generic version of a game.

A 360° Game, which fits within the larger family of serious analytical games, is designed to assist decision-makers, program managers, and researchers characterize, analyze, and respond to complex, multifaceted problems in the quickest and most comprehensible way. It does so by assembling a cross-section of stakeholders, subject-matter experts, and hands-on operators to interactively investigate the problem from an encompassing set of perspectives and approaches. The design is objective-driven to reveal solutions to a given target problem. It employs exploratory analysis to provide insights and learning experiences, but not decision-level answers. These results are attained through the application of a rigorous discovery methodology.

The 360° Game is best suited for situations in which the sponsor is dissatisfied with, or uncertain about, already proposed solutions. It may also be useful when other analytical approaches have proven insufficient.

During the game, participants play their assigned roles, report to the game's Senior Official, and search for solutions to some specific aspect of the game's overall target problem. Players interact within functional breakout teams or cells, which are facilitated by professional research staff. The game is played across a number of contextual vignettes (or alternative futures), which allows for triangulated analysis contributing to "360 degrees" of analysis of both the problem and candidate solutions along several analytical dimensions.

The 360° Game is played in a single, full day at a dedicated venue, moving back and forth between plenary and breakout activities. Thirty to 60 players are divided into interdisciplinary cells in which they brainstorm, discuss, assess, and report candidate solutions for their slice of the bigger problem, which is given to them in the form of a multimedia scenario/alternative future.

Research staff provide a research foundation, read-ahead materials, game-day activities (including facilitation within the breakout cells, the plenary multimedia vignettes, and rapporteur services), and postgame analysis of participants' inputs and insights, along with reporting of the results.

360° GAME AND SERIOUS GAMING BACKGROUND

This report is designed to facilitate an understanding of the 360° Game's capabilities, utility, and efficacy for researchers, project leaders, and sponsors. It provides background on the game as part of the larger family of serious games, along with guidelines for scoping, developing, and running a generic 360° Game.¹

The 360° Game was developed in support of DARPA in 2015, to discover solutions for an aspect of one of its enduring challenges: technology transfer. But, the 360° methodology also has broad application across a spectrum of organizations faced with complex, multifaceted problems that have not proven themselves friendly to other analytical approaches. For instance, the 360° Game has been successfully applied to the challenge of developing an overarching cybersecurity framework that considers the roles of government, industry, advocacy organizations, and academic institutions and how each group's concerns relate to the other groups.²

This report serves as a practitioner's guide for those decisionmakers, program managers, and researchers interested in applying the RAND 360° Game. We address objectives, mechanics, needed development and support resources, and value as an analytical tool. We draw on the results of a 360° Game run for DARPA in January 2015, along with results of Hewlett 360° Games in August 2015 and February 2016.

RAND Games Resemble Games in Everyday Life

By way of background, serious or analytical games are conducted in a professional environment and designed to understand the "how" and "why" of a complex situation or condition, particularly one in which human engagement plays an important role. This family of games resonates with the life experiences of participants. These games have the same essential components as in the real world, where multiple independent players are largely governed by a set of accepted rules, are subject to an evolving environment that changes with uncontrollable events and player interactions, and are rewarded for successfully cooperating or competing to achieve individual and collective goals. Therefore, serious games can be applied as shorthand for real-world organizational and/or societal challenges.

As humans, we are sometimes irrational and unpredictable in the face of challenges, but we can also demonstrate phenomenal ingenuity when given problems to solve. Serious games allow the investigator to integrate both rational and irrational elements of analysis into difficult, multifaceted challenges. These games essentially pit a player or players against a scenario or against one another. In a 360° Game, the scenario is the opponent, challenging players to solve the complex problems it presents.

Much of what we seek to explain in the gaming world is emergent behavior, resulting not just from any specific event, but from the interactions of many choices by many parties, all

taking place in the shadow of uncertainty. Just as the world is run by and for human beings, who are immersed and engaged in their intersecting professional and personal endeavors, serious games can be engineered to expose emergent group synergies and dissonance that can be respectfully leveraged and overcome in solutions to these real-world challenges. Gaming allows us to generate an immersive synthetic environment where these dynamics can be analyzed.

RAND Has a Long History with Gaming

The 360° Game comes from a long line of gaming at the RAND Corporation. Onetime RAND researchers such as Nobel laureates John F. Nash, Thomas Schelling, Lloyd S. Shapley, and Herbert Alexander Simon were key figures in the elaboration of games and gaming theory in the 1940s, 1950s, and 1960s. The famous “prisoners’ dilemma” game was created by Melvin Dresher and Merrill M. Flood at RAND in Santa Monica. By 1970, RAND had published more than 400 books and reports on game theory and the results of gaming and exercises.³ More-recent examples of RAND gaming methodologies include The Day After construct,⁴ the Concept Operations Group,⁵ and the Structured Workshop methodology.⁶

Different Games Meet Different Objectives

Serious games—the 360° Game, in particular—seek to investigate what we cannot effectively experiment with in the real world. For instance, we do not want to suffer a biological attack to explore responses and implications.

Serious games come in many flavors. They can be simple experiments in game theory.⁷ They can also be computer-based, in which the power of rapid computation assists in presenting information, analyzing consequences, or representing artificial players. Some games can be played around a table, similar to entertainment games in which boards provide a view of the analytical landscape and tiles, tokens, or figures represent activities, statuses, or entities. Finally, games can be played in a workshop venue, where a number of participants can be accommodated and a greater diversity of insight gained.

A serious game, regardless of type, can have different objectives. We can use games to train or familiarize players in complex arenas. By immersing people of disparate backgrounds and responsibilities in a common environment, we can spark or enhance communication and collaboration among those who otherwise would never see the benefits of

interacting, or would lack a compelling opportunity to do so. We can also use games to test plans or support decision-making, and games can explore a problem space that may be too ill-defined or poorly understood to be examined in other ways. Finally, nothing opens minds like experience, and games are experiential. Generally, games are malleable, and any combination of these types and objectives can be integrated to meet a specific need.

The 360° Game can be used as a multidimensional analytical tool for complex problems with any combination of objectives or formats. So far, it has been employed in the DARPA and Hewlett games specifically in support of problem exploration in a workshop environment.

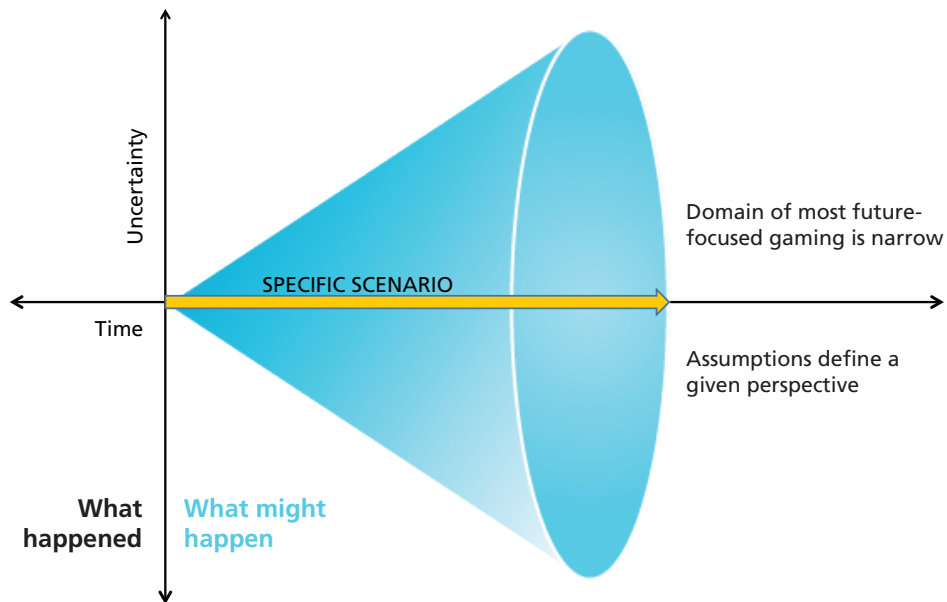
360° GAME CHARACTERISTICS

Most games look to the future in which uncertainty is obviously greatest, as illustrated in the “gaming cone” (Figure 1). Thinking of this cone as representing the three-way trade-space between scenario versatility, certainty, and time frame, we see that games play out in an uncertainty-space that we can visualize as a plot of time versus uncertainty. As a scenario’s specificity is held constant, the certainty and versatility of the scenario decreases proportional to how far in the future the researcher seeks to investigate. This is a common dilemma faced by game designers whose clients seek to solve future problems, in a versatile manner, with maximum certainty. Since this future uncertainty increases with its distance from the present, most future-oriented games compensate by anchoring their scenario in a limiting set of assumptions or a single scenario. But this similarly limits the versatility and applicability of a game’s findings. While such an approach allows for detailed investigation of a specific future by the researcher, it simultaneously constrains the value of the game’s findings, especially outside of the specified assumptions or scenario.

At some given point in the future—when challenging, multifaceted problems demand to be addressed—there exists a full multiplicity of reasonable alternative futures covering a broad spectrum of uncertainties for which a scenario-specific analysis is of limited value.

The strength of the 360° Game is that it allows for analysis across this broader expanse of a problem’s uncertainty-space by providing multiple scenarios, using multiple analytical perspectives, and applied to multiple research disciplines from which to experiment and observe.

Figure 1. The Gaming Cone



The game accomplishes this by approaching the problem from as many different aspects and across as many analytical elements as practicably feasible—in a 360° fashion (Figure 2).

Employing a 360° Game increases the degrees of freedom with which to investigate the potential option-space of the sponsor’s problem. The game designer can select which analytical elements to hold fixed and which to vary to best investigate the aspects of the problem of greatest value to the sponsor—without degrading the integrity of the methodology or the quality of the research (Figure 3).

Overall, the 360° Game is designed to characterize, analyze, and respond to particular complex, multifaceted problems in the quickest and most comprehensible way. It does so by assembling a cross-section of stakeholders, subject-matter experts, and hands-on operators to investigate the problem from an encompassing set of perspectives and approaches. We describe the game design methodology in the next section.

360° GAME DESIGN METHODOLOGY

The starting point is to determine whether the sponsor’s problem can be addressed using a 360° Game. The sponsor will get the most value if the problem exhibits three characteristics:

- **complexity:** neither comprehension of the problem nor its solutions are trivial

- **multifaceted:** many different skill sets needed to appreciate and address all aspects of the problem to its greatest depth
- **unsolved:** while sponsors might be considering, or been offered possible solutions, they are sufficiently unsatisfied with the proposed solution that they are interested in continuing to search for a better solution.

While this might seem like a straightforward task, the problem must be clearly articulated because the rest of the game’s design is dependent on it. Researchers might need to integrate a number of characterizations of the problems, until both the sponsor and the research team agree that they have a clear, concise, and coherent way of articulating the problem. A dry run of the game helps ensure that clarity has been achieved before entering the execution phase of the game.

Candidate Solutions

Once the game is properly characterized and articulated, the next step is to assemble as many candidate solutions to the problem as feasible. The candidate solutions can come from three sources:

- the sponsor or his or her staff, who may have a solution or solutions they are considering or be aware of solutions considered previously
- research, which should supplement the sponsor’s set of possible solutions (The best number of solutions will be a

Figure 2. The 360° Gaming Cone Uses Multiple Perspectives

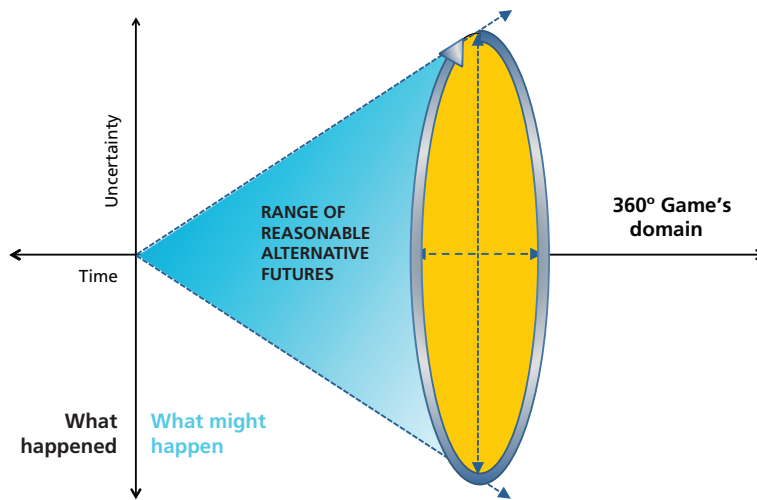
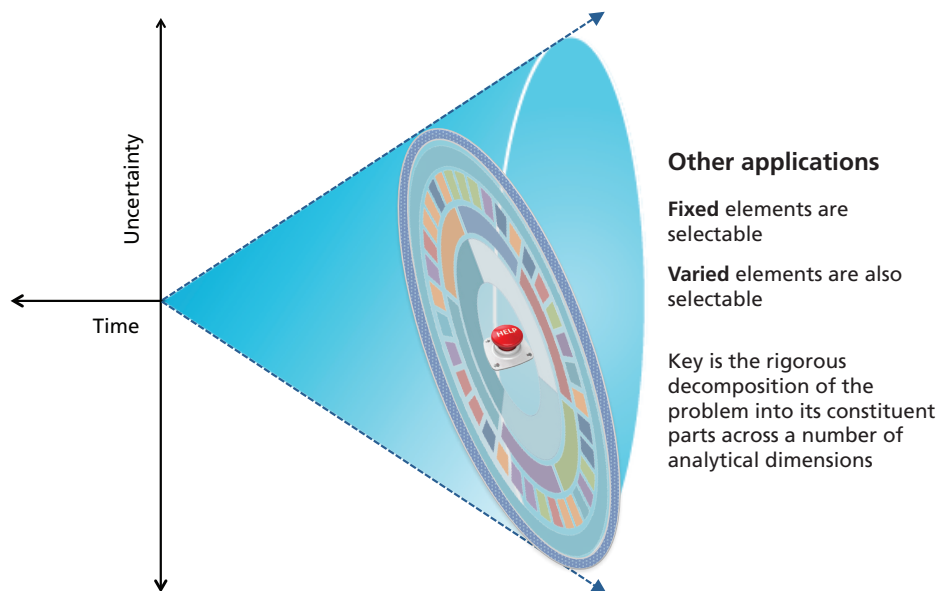


Figure 3. The 360° Game Can Analyze from Many Perspectives



function of the sponsor's problem. Some will need many solutions; some will need just a few. Regardless, the research team needs to ensure that a thorough examination of the literature, the current thinking in the fields associated with the problem, and its own brainstorming has covered all feasible options. The quality of the game's output is related to the completeness, viability, and variety of candidate solutions.)

- game play, when participants respond to novel situations in spontaneous and ingenious ways and offer potential solutions on the fly. (These candidate solutions, sparked by triggers in the scenarios/vignettes or the ideas of other players, should be considered on an equal footing with those from the other two sources, but they will not be captured until the game.)

Vignettes

With an articulated problem and candidate solutions in hand, the next step in the 360° Game's methodology is to create a set of vignettes from which to view both the problem and potential solutions.

The game is constructed to be conducted in a single day, leaving only enough time to address two or three vignettes. These vignettes are presented in a crawl-walk-run fashion, increasing in complexity and difficulty with respect to the problem. This is to accommodate the players' adjustment from the real world they left when they entered the game to a world where they are fully immersed in the game, its objectives, and their role as players.

These vignettes need to be developed such that each gives a unique, independent perspective on the problem. They are intended to effectively triangulate the problems, addressing all key aspects needed to be considered to develop a robust solution. The vignettes should represent credible and pivotal alternative futures where the problem manifests itself.

Breakout Teams

The next part of the 360° Game's methodology is to break down the problem to its functional parts. This functional decomposition can be based on temporal, organizational, or process considerations. Regardless, to the best extent practicable, they should provide global coverage of the problem, while also being mutually exclusive.

The elements of this functional breakdown will be used to differentiate breakout teams during game play. For example, in the DARPA game, RAND developed six functions that represented the major processes involved in Special Operation Forces (SOF) operations:

- command, control, communication, and planning
- intelligence, surveillance, reconnaissance (ISR)
- influence operations, in which battlespace effects are generated through nonkinetic means
- firepower, in which battlespace effects are generated through kinetic means
- mobility
- logistics and combat support.

A separate breakout team populated by a cross-section of participants from different areas of expertise was then established for each of the six functions. This use of functionally organized, multidisciplinary teams is a key aspect of the 360° Game and differentiates it from most other approaches.

Although the specific functions will vary with the problem, what does not vary is that these functions provide the organizational construct for the breakout teams. Each participant will be assigned to a specific breakout team. In some cases, the breakout teams are assigned for the entirety of the game, while in other cases the composition of the breakout team may be changed for the different vignettes. The number of individuals in each of the functional elements/breakout teams should be proportional to the total number of participants attending. There should be between four (30 participants) and seven (60 participants) breakout teams. With fewer than about 30 participants, there is a risk of not having good representation of

diverse views. With more than about 60 participants, the game becomes difficult to manage.

Team Expertise

As discussed, the functional breakout teams are populated according to participants' discipline/expertise. Specific team assignments are made by the research team, in consultation with the sponsor, to ensure that each team has both the needed set of disciplines and diversity of perspectives (e.g., technological, operational, policy/legal) to understand all dimensions of the problem. For this reason, it is critically important to have the needed cross-section of stakeholders, subject matter experts, and operators in the game.

The alignment of functional breakout teams and cross-disciplinary expertise is an important part of game design. Each breakout team provides a group of cross-disciplinary experts looking at the problem from a number of pivotal perspectives (vignettes) through a functional filter with the needed breadth and depth of subject matter insight. Combining the collective talent provides 360 degrees of perspective, functional analysis, and expertise to characterize, analyze, and respond to the problem in question in the quickest, most comprehensible way.

Measures of Effectiveness

Each breakout team assesses multiple solutions to the functional part of the problem that they have been assigned. Measures of effectiveness (MOEs) are provided to estimate the value of each candidate solution. MOEs vary from game to game, from vignette to vignette, and from team to team. For example, in the DARPA game the MOEs for the communications breakout team included such factors as the available bandwidth, size, weight, and power of the equipment; degree of communication security provided; covertness or probability of intercept; and range. By contrast, the breakout team addressing influence operations had such MOEs as languages and dialects translated; ability to facilitate social interactions with individuals and groups who do not share a common language, culture, or other defining experiences; and ability to map social sentiment. The values of these MOEs for each solution were compared with the breakout team's estimate of what would be needed to support SOF operations in the vignette under consideration.

Selecting and, in some cases, developing appropriate MOEs is a key part of game design. MOEs provide each breakout team with a link between candidate solutions and the functional needs of the team. The problem characterization,

functional decomposition of the problem, and MOE selection drive the final results, and should be a focus in the early stages of game development.

The game play involves presenting vignettes to the players. After that, the players are given tasks from the game's Senior Official, and then break into groups to assess their assigned candidate solutions against their assigned MOEs.

Each breakout team is facilitated by professional staff, and deliberations and assessments are recorded by a rapporteur. Within the artificial environment of the game, the facilitator is a member of the Senior Official's staff—an expert in what the Senior Official expects from his/her team but not in the subject matter being discussed. Therefore, the facilitator does not lead the group's discussion but rather channels it when needed to keep it congenial, focused, and productive. The facilitator ensures that the group's expertise is maximized by managing overbearing participants and drawing out reticent participants. When appropriate, the facilitator provides perspective, answers questions not specifically addressed in the vignette, and explains game mechanics.

Measures of Performance

Following the game, research staff takes their notes of their breakout group's deliberations and assigns fitness scores to each of the candidate solutions their group assessed as being viable. These fitness scores are based on criteria, developed in coordination with the sponsor, that capture other factors that may affect the solutions' viability for the sponsor's needs, such as cost, time to mature the solution, technical and operational complexity, and risk.

Summary

The 360° Game methodology provides in-depth analysis of the sponsor's problem and a comprehensive assessment of competing solutions. It does so by

- functionally analyzing the solutions with respect to pivotal vignettes
- employing the collective insight of multidisciplinary teams, each addressing a different functional aspect of the problem
- measuring the effectiveness in providing value to the sponsor's needs
- scoring candidate solutions relative to their fitness with implementation criteria.

360° GAME EXECUTION

No two 360° Games will be identical. But based on the three games played to date, a generic game day time line provides a general feel for how a game is executed.

- Participants are asked to be ready by early morning of game day. For the DARPA and Hewlett games, the start time was 8 a.m. In the weeks prior, participants were given a detailed schedule of events and read-ahead materials for the game's focus area. Because not all participants can dedicate the same amount of time to preparation, the first hour is used to get everyone on the same footing.
- Then, using the crawl-walk-run approach, they are presented an immersive multimedia scene setter, followed by the first, and relatively simple, analytical vignette, which is similar to a focused scenario in other types of games. With the analytical terrain in place, participants are assigned to functional breakout groups and tasked by the game's Senior Official,⁸ to whom they report back at the conclusion of the breakout session. Each of these breakout teams is facilitated by a member of the research staff who is familiar with the 360° Game, the cell's functional area, and the sponsor's analytical interests. A separate staff member captures key areas of discussion in the group. At the end of this phase, the groups reconvene in a plenary session, where they individually provide the Senior Official with a thumbnail sketch of their group's results. The Senior Official interacts with the groups to ensure the work is effectively aligned with the sponsor's research interest.
- The next phase follows the same steps, but the vignette is more complex and set in a more challenging environment. More time is allotted for deliberations and reporting.

The 360° Game methodology provides in-depth analysis of the sponsor's problem and a comprehensive assessment of competing solutions.

- The final phase replicates the above steps, but presents an even more complex vignette within a harsher environment.
- The closing segment consists of a workshop discussion of what was learned and how it might be applied.
- Research staff package the collective game insights into a quick-look report and use detailed notes from the game to conduct follow-on analysis and create a comprehensive report.

Executing a 360° Game requires a number of considerations, only some of which have been addressed in this report. For researchers, project leaders, and sponsors interested in considering the 360° Game as a potential analytical tool, a number of pregame activities and game day resources should be addressed. We discuss these next.

Game Design Process

The 360° Game design involves appropriately characterizing the problem to be investigated. Many times the sponsor will be familiar with the symptoms of a problem—but in order to properly design the 360° Game, the problem's causes need to be understood. Depending on the maturity of the research team in understanding the problem, this initial step may require the most research of the entire 360° Game process, but will likewise pay the greatest dividends. Part of this research of the problem should involve previously proposed solutions and why they proved unsatisfactory.

Pregame Activities

A set of pregame activities would include the following (note that this is not necessarily the order in which they would be accomplished):

- designing the games, as addressed earlier
- working with gaming experts and research communicators to craft appropriate vignettes that are both substantively viable and have a presentation quality that engenders suspension of disbelief on the part of the game's participants
- assembling a research and administrative team to develop, assemble, and disseminate read-ahead and game day materials for 360° Game participants and staff⁹
- finding, inviting, committing, and balancing the strongest feasible set of participants for game day.¹⁰

Game-Day Resources

Execution of the game itself will need to build on the activities above, along with meaningful rehearsals, murder boards, and sponsor briefings. Logistically, a number of activities will lead to a successful game. Chief among them is obtaining the appropriate venue. The right choice of venue will be dictated in part by the nature of the problem, sponsor, and participants (e.g., security, location, and creature comforts). In addition, game designers should look for a venue that provides an environment free from work-day distractions and interruptions. There should be quality space for the plenary session and six breakout sessions, as well as space for catering. Good quality audiovisual services are also key for the plenary sessions, in which the vignettes are presented.

Manpower Requirements

These activities require resources—time, manpower, and talent. Researchers, project leaders, and sponsors should be comfortable with the resources needed before embarking on a 360° Game. The design phase normally takes two months of work by two senior staff familiar with the 360° Game and the sponsor's problem—assuming the problem is well understood. If not, then sufficient time by a team of researchers will be needed to appropriately address this immaturity. Once the problem is characterized and previously attempted solutions understood, then gaming staff and a research communicator should be engaged to assist in developing the game-day vignettes that will be presented to participants. Vignette development should be done interactively between senior research staff, gaming staff, and the research communicator for best results—each has a unique and indispensable contribution needed to make a quality product. At least a month before game day, the facilitator team should be selected and integrated into the game development process.

During the three games played to date, it was found that the facilitators can effectively play the role of internal quality assurance as they prepare for their game-day role within the breakout teams. During actual game play, note-takers/recorders will be needed within each of the breakout teams and during the plenary sessions to capture the participants discussion and insights.

Postgame

Finally, after the game is played, the resulting data (in the form of participant comments, staff observations, and recorders' notes) needs to be gathered, collated, analyzed, and synthesized for inclusion in a quick-look report for the sponsors—ideally

within a week of the game. Follow-on standard formal reporting will also need to be resourced.

Key Preparation Steps

While the previous discussion addressed functional activities needed for a successful 360° Game, there are 19 key sequential steps that need to be taken in preparation for a game (Table 1). These steps can act as a guide for researchers, project leaders, and sponsors in understanding the specifics needed to assemble a successful 360° Game.

An important ingredient of success for a 360° Game is close collaboration between the research team and the sponsor. Table 1 lists the optimum collaborative relationship for each of the 19 steps, showing which organization should lead and which should support. RAND is responsible for the 360° Game's development and execution, thus also responsible for most of the tasks, with the sponsor playing an oversight role (listed in the "support" column of Table 1).

The sponsor should play an equal, if not leading, role (listed in the "lead" column in Table 1) in three tasks. First, all past proposed solutions that the sponsor considered need to be well understood by the research team—the reason for their initial selection, how they were applied to the problem, and why the sponsor and others feel they were insufficient. Second, developing the list of most-qualified and best-fit participants needs to be done in close partnership with the sponsor. Most times, the sponsor will be in a better position to identify the lead thinkers regarding various aspects of the problem under investigation. In instances when the research team is concerned that a sponsor-nominated participant doesn't meet the needed level of expertise, the research team should consider the sponsor's reasoning and attempt to address the sponsor's underlying motivation. Finally, when practicable, it is best for the sponsor, or their superior, to issue the formal invitation to the game. Normally the sponsor will be positioned to have more influence over the invitee's decision to participate than will the research team.

Table 1. Nineteen Sequential Steps to Building a Successful Game

Step	Task	Lead	Support
1	Characterize the "problem"	RAND	Sponsor ^a
2	Develop criteria for qualification as candidate solution	RAND	Sponsor ^a
3	Identify and characterize sponsor candidate solutions	Sponsor	RAND
4	Research and characterize other potential solutions	RAND	Sponsor ^a
5	Decompose problem functionally	RAND	Sponsor ^a
6	Decompose problem by discipline	RAND	Sponsor ^a
7	Develop participant list for game	RAND and sponsor ^b	
8	Invite participants	Sponsor	RAND
9	Research and develop applicable MOEs	RAND	Sponsor ^a
10	Research and develop applicable MOPs	RAND	Sponsor ^a
11	Develop crawl-walk-run vignettes that triangulate the problem (as defined in Step 1); engage relevant functions (defined in Step 5), and disciplines (Step 6); and are applicable to developed MOEs (Step 9) and MOPs (Step 10)	RAND	Sponsor ^a
12	Iterate above as appropriate to achieve robust game design	RAND	—
13	Develop game-day agenda, timeline, and tasks	RAND	Sponsor ^a
14	Develop mechanics and guidance for breakout sessions	RAND	Sponsor ^a
15	Develop read-ahead list and materials	RAND	Sponsor ^a
16	Develop on-site game-day resources for participants and staff	RAND	—
17	Conduct dry run	RAND	Sponsor ^a
18	Make needed adjustments	RAND	Sponsor ^a
19	Assemble game-day materials	RAND	—

^a Sponsor support consists of giving guidance, insight, and informed consent, as appropriate.

^b Sponsor and RAND share lead and support duties.

CLOSING

The 360° Game delivers value to researchers, project leaders, and sponsors by providing a 360° investigation of a complex, multifaceted problem set against potential solutions. The previous sections endeavored to facilitate an understanding of how this is accomplished.

The game has been successfully employed in three venues. In each of those instances, the 360° Game looked across alternative futures, disciplines, functions, and effectiveness and fitness criteria to provide a 360° investigation of the problem of interest. The ability to investigate the solution space quickly and extensively with a cadre of subject-matter experts allowed for a practical, best-fit solution to complex, multifaceted problems. In the process, each of these 360° Games also delivered ancillary benefits. The game's format, which experientially engages participants, increased their buy-in of the developed solution. In addition, the participants' engagement in the game increased their appreciation for the target problem's complexity, the need for a collaborative effort outside their own areas of expertise (along with an appreciation of the contribution of other disciplines), and an understanding of how to approach other complex, multifaceted problems.

Despite the success, it should be recognized that the 360° Game is not a perfect analytical tool. It has key dependencies that are directly related to the quality and veracity of its results.

Key among these is the quality of the participants. The game's output cannot be any better than the collective capability of the participants—on their best day. Selection of quality participants needs to be done with strong sponsor engagement. It is often best if the lead of the sponsor's organization invites participants, thus demonstrating leadership's commitment to the exercise.

Additionally, if the game is going to correctly target the sponsor's needs, frequent and meaningful interaction is needed. Finally, balancing game design, the participant's assignment, the vignette believability, the application of analytical tools, game support, and postgame analysis is not trivial; it requires a high-quality research team with experience and energy.

It should also be noted that this tool only provides exploratory results, sufficient to point the researcher, manager, or sponsor in the right direction, but insufficient for high-consequence decisionmaking. Normally, follow-on detailed analysis, based on the 360° Game's results, will be needed to support such decisions.

Employing a 360° Game is quite broad in its potential application and sponsorship. A number of 360° Games have been or are being investigated by different sponsors. As noted, RAND first used the 360° Game to help DARPA address the challenges of technology transfer. More recently, RAND has been conducting a series of 360° Games sponsored by the Hewlett Foundation to develop a cybersecurity framework.¹¹

Notes

¹ A *serious game* is one designed for a purpose other than pure entertainment. In the case of a *serious analytical game*, that purpose is to solve a particular problem.

² For purposes of the 360° project, such a framework was defined as the common and inclusive depiction of the field of study (cybersecurity), presented at the highest level of analysis that both delivers meaningful insights and provides a basis for dialogue across stakeholders. RAND supported the Hewlett Foundation's Cyber Initiative. William and Flora Hewlett Foundation, "Cyber Initiative," undated. As of May 9, 2016: <http://hewlett.org/programs/special-projects/cyber-initiative>.

³ A 2009 review of the history of the field dedicates an entire section to the influence of the RAND Corporation. See Igor Mayer, "The Gaming of Policy and the Politics of Gaming: A Review," *Simulation and Gaming*, Vol. 40, No. 6, December 2009, p. 829.

⁴ See, for example, Marc Dean Millot, Roger C. Molander, and Peter A. Wilson, "The Day After . . ." *Study: Nuclear Proliferation in the Post-Cold War World*, Vol. II Main Report, Santa Monica, Calif.: RAND Corporation, MR-253-AF, 1993. As of October 5, 2016: http://www.rand.org/pubs/monograph_reports/MR253.html

⁵ John Birkler, C. Richard Neu, and Glenn A. Kent, *Gaining New Military Capability: An Experiment in Concept Development*, Santa Monica, Calif.: RAND Corporation, MR-912-OSD, 1998. As of October 5, 2016: http://www.rand.org/pubs/monograph_reports/MR912.html

⁶ Shoshana R. Shelton, Edward W. Chan, Christopher Nelson, David J. Dausey, Debra Lotstein, John A. Zambrano, Andrew M. Parker, and David M. Adamson, *A Workshop Template to Assess and Improve SNS Planning*, Santa Monica, Calif.: RAND Corporation, WR-639-DHHS, 2009. As of October 5, 2016: http://www.rand.org/pubs/working_papers/WR639.html

⁷ Game theory is a branch of mathematics that addresses how decisions are made in situations in which one entity's decision affects another entity.

⁸ Every effort should be made to make the assignment of participants to their teams as straightforward (and quick) as possible for the participants. Experience has shown that coding their game-day nametags with icons that correlate to their team and match icons designating their team's breakout space is both quick and effective.

⁹ Serious consideration should be given to using the pregame research and administrative staff as facilitators and note-takers during the execution phase because, through their research and planning, they gain familiarity with the material.

¹⁰ This should be done in close collaboration with the sponsor as the quality and value of the outcome will be directly proportional to the expertise and quality of participants.

¹¹ Mikolic-Torreira, Igor, Ryan Henry, Don Snyder, Sina Beaghley, Stacie L. Pettyjohn, Sarah Harting, Emma Westerman, David A. Shlapak, Megan Bishop, Jenny Oberholtzer, Lauren Skrabala, and Cortney Weinbaum, *A Framework for Exploring Cybersecurity Policy Options*, Santa Monica, Calif.: RAND Corporation, RR-1700-WFHF, 2017. As of May 23, 2017: https://www.rand.org/pubs/research_reports/RR1700.html

About This Report

This report describes the RAND Corporation's 360° Game, a "serious analytical game" developed in 2015 under Defense Advanced Research Projects Agency (DARPA) sponsorship to discover prospective solutions for an aspect of one of DARPA's enduring challenges—technology transition. The 360° Game has broad application for a wide spectrum of researchers, project leaders, and sponsors who are faced with complex, multifaceted problems that have not proven amenable to other analytical approaches. This report presents a tutorial for those interested in using this RAND analytical gaming tool.

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