

Fluid Mosaic Terrain

Players care deeply about their own empires, not about the stability of the global game map. Fluid Mosaic Terrain sacrifices a fixed global map to preserve individual empires, allowing players to enter and exit freely from an ongoing game, easily seeking friends and foes matched to their size and skill.

Introduction

Imagine a grand game of empire in which hundreds and even thousands of player empires interact closely for production, attack and defense.

Player empires vary greatly in size and shape, yet by using stratified arenas, players can choose to play with others of similar size or skill – minnows can avoid the sharks.

Fluid Mosaic (FM) games (FMG) allow players to engage with friends and foes much quicker than fixed terrain games. This relatively rapid movement creates a much more dynamic game map, forcing players to adapt to their changing environment – usually by better coordination with their allies and trading partners.

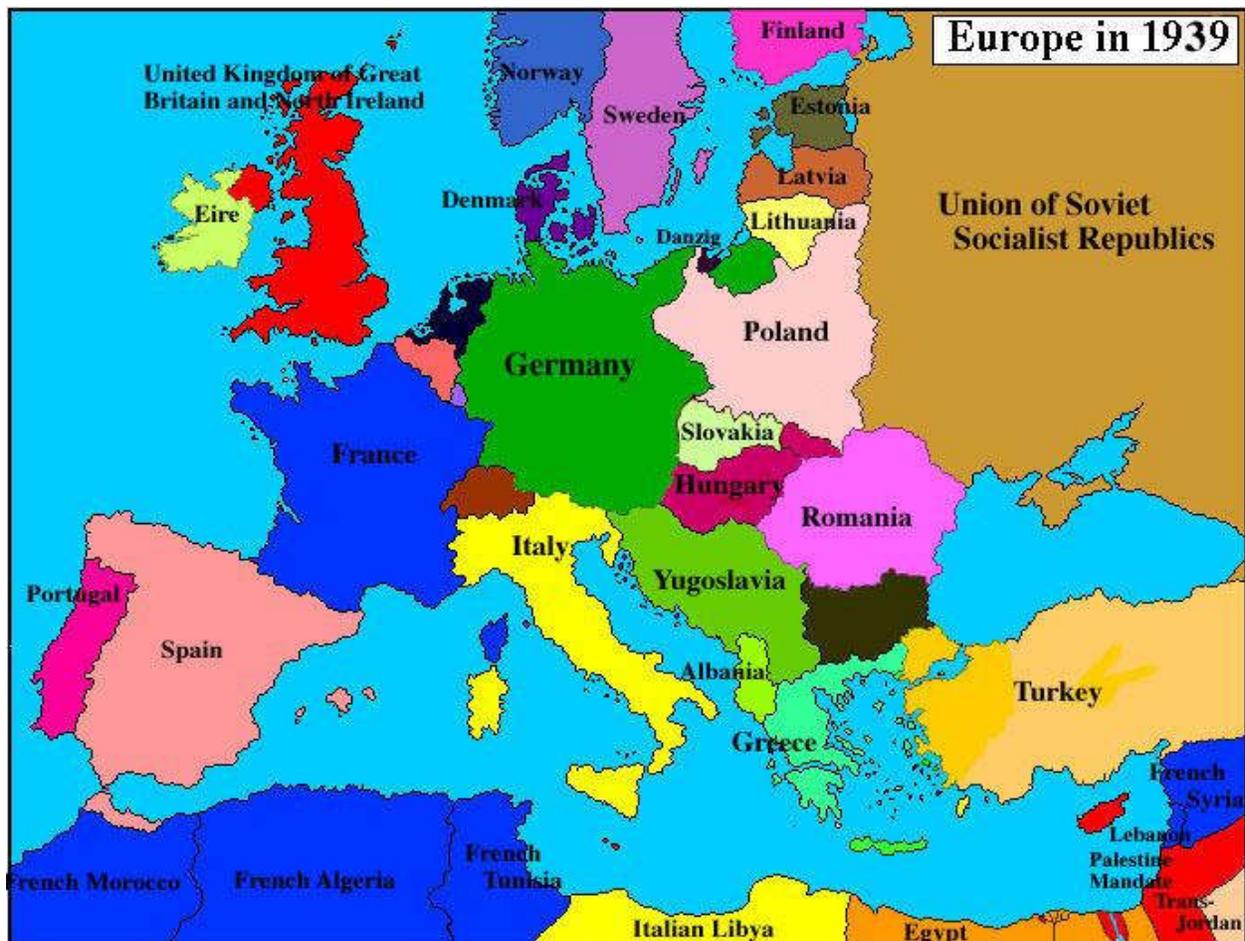
Increased engagement in FM games (FMG) means that smaller FM arenas with fewer players produce greater activity than larger Fixed Terrain (FT) Games (FTG). Smaller arenas require fewer data and processing resources, and allow more stratification and arena selection to improve player experience.

Each FM player territory has a balance of offense, defense, speed and production. But FM territories need not be monolithic – a single player can control multiple smaller territories that comprise his empire.

Many FM games run continuously, exploiting the important FM advantage that players can enter and leave easily, preserving their “precious empires” for their return.

Features and Limitations of Fixed Terrain

To understand Fluid Mosaic Terrain, let us first consider the characteristics of ordinary Fixed Terrain. A typical fixed terrain map of Europe is provided below.



Each territory/country is surrounded by other territories or water. The borders between countries are thin lines, sometimes due to natural structures such as rivers, that do not change in thickness. Country shapes are unique, but the land does not change shape or position, so we call this Fixed Terrain.

The map can also be viewed as a Mosaic - a picture composed of

multiple tiles (countries). Since the tiles do not change in shape or position, we call this a Fixed Mosaic terrain map.

Fixed terrain maps create important problems which limit quality interaction in multiplayer games - mostly from the fixed positions, sizes and shapes of the territories. Regarding the map of Europe, the fate of many of the countries is largely dictated by their size and position – causing them to be repeatedly overrun. Smaller countries surrounded by larger countries have no opportunity to expand. A western European country cannot easily maintain a direct alliance with an eastern European friend.

In continuously running games, player entry and exit is a more profound problem. When a player enters, is there a void in which to place him? Has that void been there since he left? When a player leaves, does that create a functional void in the map? Is a player allowed to save his empire on leaving, bringing it back with him on his eventual return? Some of these propositions are practically nonsensical in a fixed terrain map, unless the map is very large with lots of empty space, which by itself limits player interaction.

Fluid Mosaic addresses Fixed limitations

Let us improve our Mosaic map with a simple innovation – assume that the “mortar” connecting our tiles is not a thin line of fixed cement holding them together, but a variable thickness of “fluid mortar” which allows tiles to move freely.

Europe is no longer a monolithic continent – the countries can now drift freely in the fluid mortar (sea) and positions can change. A western European country can actually float near his eastern friend.

Since countries (tiles) in the Fluid Mosaic model are no longer cemented tightly together with adjacent countries restricting them, they can vary in size and shape. In fact, they can vary in number as well – it is possible to have 2 French players – even 10 or 100! And with plenty of fluid space in the map (e.g. the earth surface is mostly water), there is always space for a returning player.

We will now address some unique mechanics of Fluid Mosaic Terrain.

The Fluid Mosaic Tile

Although our previous discussion described countries on the map as “Tiles”, a Mosaic Tile is any territory composed of one or more contiguous positional elements (such as hexes or squares), and can vary widely in size or shape. Most games are composed of many Mosaic Tiles, distributed throughout the Fluid Mortar. Fluid mortar is similar to the sea through which Mosaic Tiles float freely.

The term “Player Tile” refers to the territory controlled by a single player. In some cases this is a single Mosaic Tile, but often, a player chooses to control multiple Mosaic Tiles, which we call a “Platoon” of Tiles.

“Platoon Tiles” are very versatile, combining Tiles of various sizes and composition which are specialized for production, attack, defense or trading. In addition to operational flexibility, Platoon Tiles may also be configured by the player on entry to the game arena, mixing and matching his empire components to create the best complement for his team and close allies. (Platoon tiles can be quite useful when entering arenas which limit the total size of a player's tiles. In these cases, a player can select multiple tiles from his inventory to meet the total, rather than having a single tile that is too big, or another that is too small. Using platoon tiles, a player is effectively able to create his own

battleship(s), and in combination with his friends in the game, effectively create a custom fleet.)

Platoon tiles may represent the perfect encapsulation of the charm and flexibility of the fluid mosaic system. As game designers, we do not design specific types of tiles, with specific production, attack and defense capabilities. We merely design the building blocks, and the properties of those building blocks (including their relative values). It is the players who build their own tiles using these blocks, and test their effectiveness (in the current environment) by combining them with cooperative tactics with their friends. All of the fascinating questions, guns vs. butter, attack vs. defense, speed vs. strength - are asked and answered by the players. As designers, we can marvel at their ingenuity and invention, rather than dictating how they must play.

Tile Movement

A player's ability to move his Tiles (empire) is an essential innovation of the Fluid Mosaic technique, allowing freedom of association not provided by fixed terrain games.

No specific mechanism for propulsion is required by FM terrain - propellers, fans, jets, even pushing animals and units may be employed. Whatever the means, it is likely that Newton's second law, $F = ma$, will be respected. The primary implication is that speed is inversely proportional to size - **smaller Tiles will move faster.**

(Note that tile movement occurs only AFTER all unit movement and attacks have been calculated. This allows a unit to reliably step to the east onto an adjacent tile, without expecting the tile to be pulled out from under him as he takes his step. Unit orders are made and executed as if the tiles are static, and THEN tile movement can occur.)

The Precious Empire (Easy Entry and Exit)

Considering the fixed map of Europe, it is hard to imagine how a player could find a place to enter an ongoing game that is sufficiently close to the action. And when a player leaves, does that create a physical or functional void in the game until he returns?

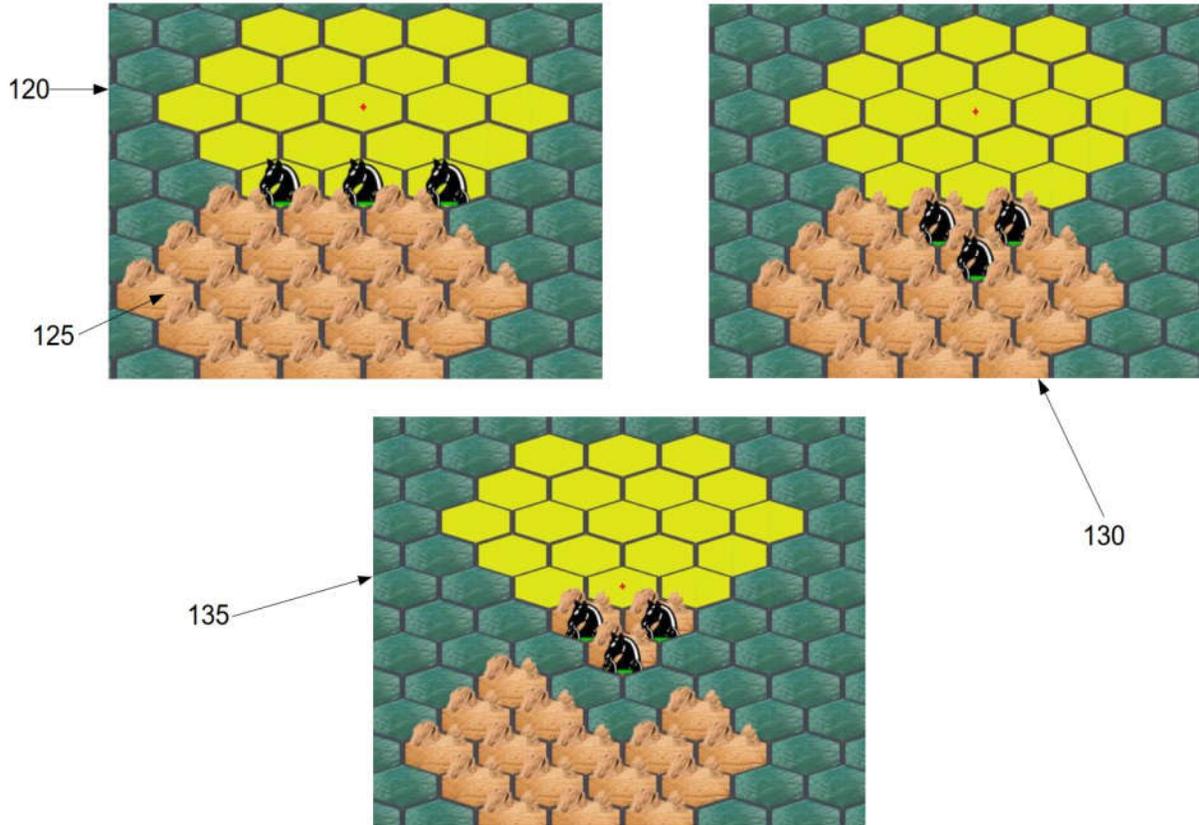
FMT provides ample fluid space between the player Tiles to allow a new player to deploy without disrupting ongoing battles, and rapidly move to allies and enemies. An exiting player removes his Tile, leaving a temporary void which is rapidly filled by nearby Tiles.

The ability to enter and leave easily, preserving a player's "Precious Empire" - the sum of his progress, ego involvement and commitment to the game. **Fluid Mosaic Terrain exploits the critical observation that players care deeply about the integrity of their empire – not about a stable game map.** By sacrificing a fixed terrain game map, players gain the ability to freely enter and exit an ongoing game, seeking friends and foes, well matched to their size and skill, and many other advantages that greatly improve player interaction. After all, a multiplayer game should maximize enjoyment through player interaction.

Capturing Territory with Fluid Mosaic Terrain

We begin our consideration of territorial capture by describing the familiar fixed terrain model. Units from one territory encroach or actively invade an adjacent territory. Defending units resist and a struggle for position ensues. The front line shifts back and forth until one or both combatants exhaust their resources or resolve, and the line tends to stabilize, with new effective territorial boundaries. Lines have changed, but land has not.

Fluid Mosaic capture is similar in the invasion of adjacent territory (Tiles), with the important exception that land is no longer fixed in position or shape. Combat persists while both sides are determined, but the player who thinks he is losing (and might lose everything) may decide to disengage and retreat with his Tile. When two Tiles separate, the areas controlled by units of each Tile tend to go with their mother Tile, with a penalty (tribute) paid by the retreating Tile (to discourage the disgraceful practice of chickening out whenever things get ugly). The retreating Tile flees with some of his Tile intact, living to fight another day, while the winner is rewarded. The size and shape of both Tiles is changed by this territory exchange.



First image illustrates the upper tile (120) moving adjacent to the lower tile (125), with three knights in the upper tile ready to invade. The second image (130) shows the three knights invading the lower tile, controlling a portion of its territory. When the lower tile decides to retreat (135), the area controlled by the upper tile units (knights) remains with the upper tile. The portion of the lower tile thus permanently captured creates a "partial victory condition", through which the rating of the upper tile and lower tile players can be adjusted using a proportional Elo (chess) ratings system.

Note that in some cases a losing player may not be able to retreat his tile away from his opponent tile(s). In such a case he can still (effectively) pull away by leaving the game. Of course, doing so will still compute

his loss of territory (and capture by his opponent(s)) as a penalty for retreating, as described above.

An important advantage of Fluid Mosaic capture is the creation of a victory event. When one empire completely conquers another, that is a complete victory event, and the ratings of the winner and loser can be adjusted according to their relative ratings, e.g. using an Elo style rating system (used for chess ratings, which we favor). But the more common occurrence in the Fluid Mosaic game is the partial (proportional) victory, where one player captures a fraction of an opponent's territory. The precise formula could vary by the game, but an illustrative example is that if a player captured 20% of an opponent's territory, he might have a 20% partial victory computed, which might be twice as valuable as capturing 10% of territory, and 20% as valuable as complete victory.

Although the Elo rating system is defined only for contests between two players, Fluid Mosaic partial victories can view the capture of territory by one player from another as an event between two players, even if several players are involved in combat. Indeed, especially with combat between players using Platoon Tiles, a prolonged battle between two players may result in multiple partial victories/defeats, modifying the ratings of the players as the battle progresses.

Ratings and Stratification

Mixing of high and low skill players is almost inevitable in Fixed Terrain games. To minimize the oppression of weaker players, arbitrary rules or limitations are often employed, impairing playability.

FMT allows more interaction with fewer players, allowing smaller arenas to be created with excellent interaction, and these arenas can be limited to specific size and skill ranges of players. Providing skill

appropriate arenas for players, and giving them the ability to quickly enter and leave arenas, allows players to actively seek their best matches for opponents.

Strategic Games with Fluid Mosaic Terrain

Imagine a large strategic game using Fixed Mosaic Terrain (FMT), such as a world war II era game, running continuously. Each of the countries (teams) could be split into multiple provinces (players), with the larger combatants (Germany, France, Britain, Russia) having many provinces and smaller countries having fewer. Players of each country might have certain types of equipment, production, resources styled after the era.

Suppose France has 80 provinces, each controlled by a player. A similar scheme would exist for Germany, Britain and Russia. At any given time, only a fraction of the players on any team would be actively playing. In this example, 18 French players, 15 German and 28 Russian players might be present. These players could engage and have combat with each other, although in the Fixed Terrain model, there might be profound limitations on which German players would be available to which French players, based on the fixed map positions.

In the Fluid Mosaic model, each country (Team) would have many players, some of which are present. An angry French player would be free to seek out many different German players, not restricted by fixed positions. As important, a German player seeking to avoid active combat could maneuver his Tile into a relatively safe position to concentrate on production, trade, etc.

Of course, the Fluid Mosaic model does not need to restrict the size of any team or the number of its players. In contrast to the reality of history or any other fixed model, the Fluid Mosaic game might have a

large number and size of Finnish players, and a much smaller number of Italians or Japanese. Perhaps the Chinese or Vietnamese could give the Japanese a real contest for Asian dominance.

Any game design based on historical eras can only be faithful in general style – it cannot be historically “accurate”, in part because even the major countries changed dramatically over time – Germany and Russia were immensely different countries in 1941 than they were in 1944. But the fluidity of the terrain creates a highly flexible and adaptive environment, created and designed less by the creators of the game than the players themselves.

We suspect the most engaging game designs would be more abstract, relying on the imagination of the players. A three team game where American, German and Russian players could all choose to fight each other for dominance might well be more enjoyable than a more “accurate” game. In truth, players in historic simulation games are not as interested in realistic depiction of the grinding brutality of war as they are in exciting game play, especially challenging other human players.

Cascade model for the Strategic game

The Cascade model combines a Strategic game with stratified arenas. Expanding on our model of American, German and Russian players fighting each other, one can envision a broad range of player skill and size, and that stratified arenas based on player skill or size would be highly desirable. Smaller players from all teams can enter in the beginner arenas, graduating with time and effort to intermediate arenas, and ultimately the strongest players fight in the advanced arenas. Most strategic games would allow some communication, trade and movement of Tiles between the different arenas, creating incentive for the stronger players in advanced arenas to assist the players in lower arenas since

their advancement is required to replenish combatants at the higher levels.

Beyond stratification based on size and skill, largely established by the game designers and administrators, a more relevant and interesting stratification will be created by the players themselves. Some arenas will tend to attract the most hardcore combat driven players (Russian front), while others may attract players interested in production (western Europe) or those interested in sea based operations (Pacific theater). Fluid Mosaic Terrain allows freedom of association by players, and players will use this freedom to create their own interactive environments in ways that designers cannot easily envision.

Warping Space and Time with Fluid Mosaic Terrain

The ability to easily enter and exit arenas while preserving the Precious Empire gives players the ability to warp space and time. Time (and the game) progresses while a player is gone, and he returns to a time beyond when he left. He will enter the arena at a different place, and the game map will have changed in his absence. He can even return to an entirely different arena. One can lament that the game map (and the progress of time) is not fixed relative to the leaving player, but better to celebrate that its fluid nature enhances opportunities for the player to find his favorite allies and enemies and improve his interactive play.

For the remaining players in the arena, time progresses as before, and the void created by the exiting player is quickly filled by adjacent players. When the player returns, he will not be placed in the middle of an ongoing battle, but more toward the periphery, so his return does not disrupt order in the arena.

Sea Based Games

Our prior discussions of Fluid Mosaic Terrain have focused on the land masses controlled by the players. While much of the activity occurs on the land of the player empires, it is important to understand that the sea can be teeming with life. Aircraft and dragons can fly above it, ships and whales can float on or beneath the sea.

There is nothing to prevent Fluid Mosaic games from having a compelling sea component like a fixed terrain game, with the bonus that the spatial relationships of the empires are constantly changing and the size and location of available sea are dynamic as well.

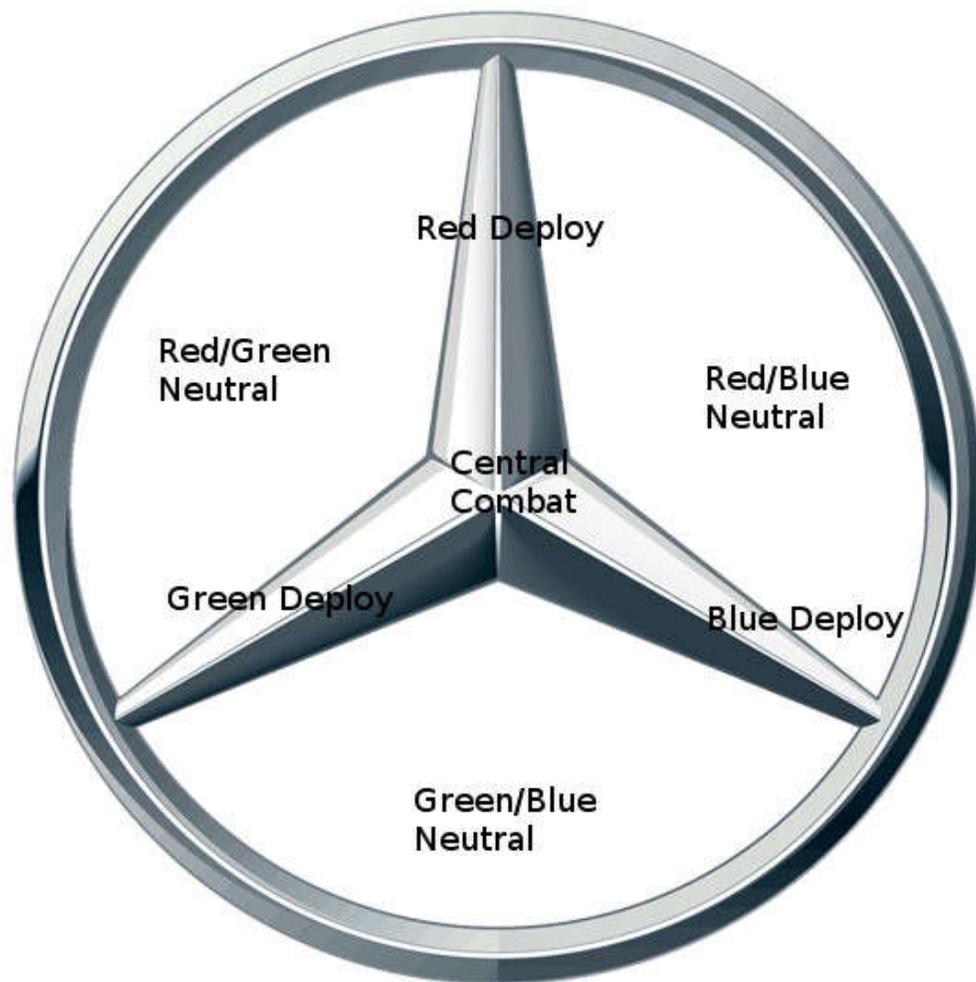
Bridging and Smoothing

Tiles will naturally acquire some jagged edges in the course of combat and territory capture. When contacting another Tile, they will stop movement (with respect to that Tile) and might have only a very small surface area (perhaps as little as one hex) over which they communicate. We believe these irregular shapes and limited areas of contact will lead to interesting tactical challenges, just as natural terrain does in reality. But it seems unlikely that two large Tiles would indefinitely have only a tiny area of communication, and natural that land bridges would form slowly to enlarge the area of contact and force a defense of a broader front or disengagement. (After all, the heroic stand at Thermopylae ended when the Persians discovered way around the hot gates.)

Similarly, too many jagged edges on Tiles may impair the game play, and some games may choose to slowly smooth these edges for playability or aesthetic reasons.

Three Team (Mercedes) Arena

Although FM arenas can have many different configurations, the three team Mercedes arena pictured below has the virtue of a symmetric design that maximizes the ability of each team to directly interact with the two other teams, as well as engage everyone in the central melee area.



Production Drives Player Interaction

The most complex and sophisticated combat units and weapon systems will require multiple resource and intermediate product inputs, and we believe that specialization and efficiencies of scale should play a role in production. Therefore, a factory of 100 size units devoted to producing iron will produce significantly more iron than 5 iron factories of 20 size units each. Although there is some convenience to players to have self sufficient Tiles producing all that they need, the most efficient strategy will be to specialize in one thing, and trade with others who specialize in the other things you need to survive.

Fluid Mosaic Terrain speeds and simplifies player interaction, but we still want to encourage players to interact by making trade and cooperation the definitive strategy for success in the game. The most effective players will form close cooperative alliances for production, attack and defense.

Although interdependence can be the key to success, it can also be a strategic vulnerability. Producing supplies in one place and transporting them to where they are needed creates opportunities for interdiction, as well as the opportunity to attack critical enemy production centers and need to defend your own. A powerful armada can be crippled by strangling its supply lines.

Many old school tactical and strategic games have rather arbitrary rules relating to encirclement and cutting off supply. Fluid Mosaic Terrain requires no specific encirclement rules. The design allows parameters for production and consumption, and the players collectively evolve their best approach.

The Easter Egg variant allows players to collect or produce several hard

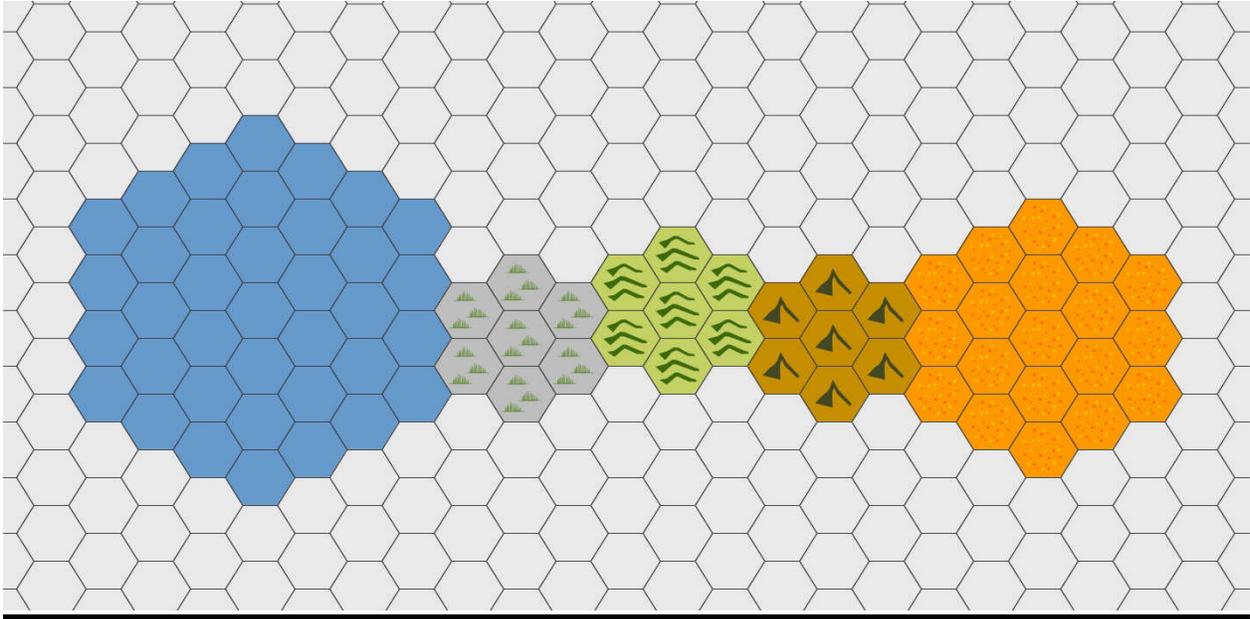
to find items in order to produce very powerful equipment or units. Some players will choose not to participate in the Easter Egg hunt, instead focusing on producing many relatively low cost but much less effective units (quantity vs. quality).

Trade/Transfer of Resources/Units between Adjacent Tiles

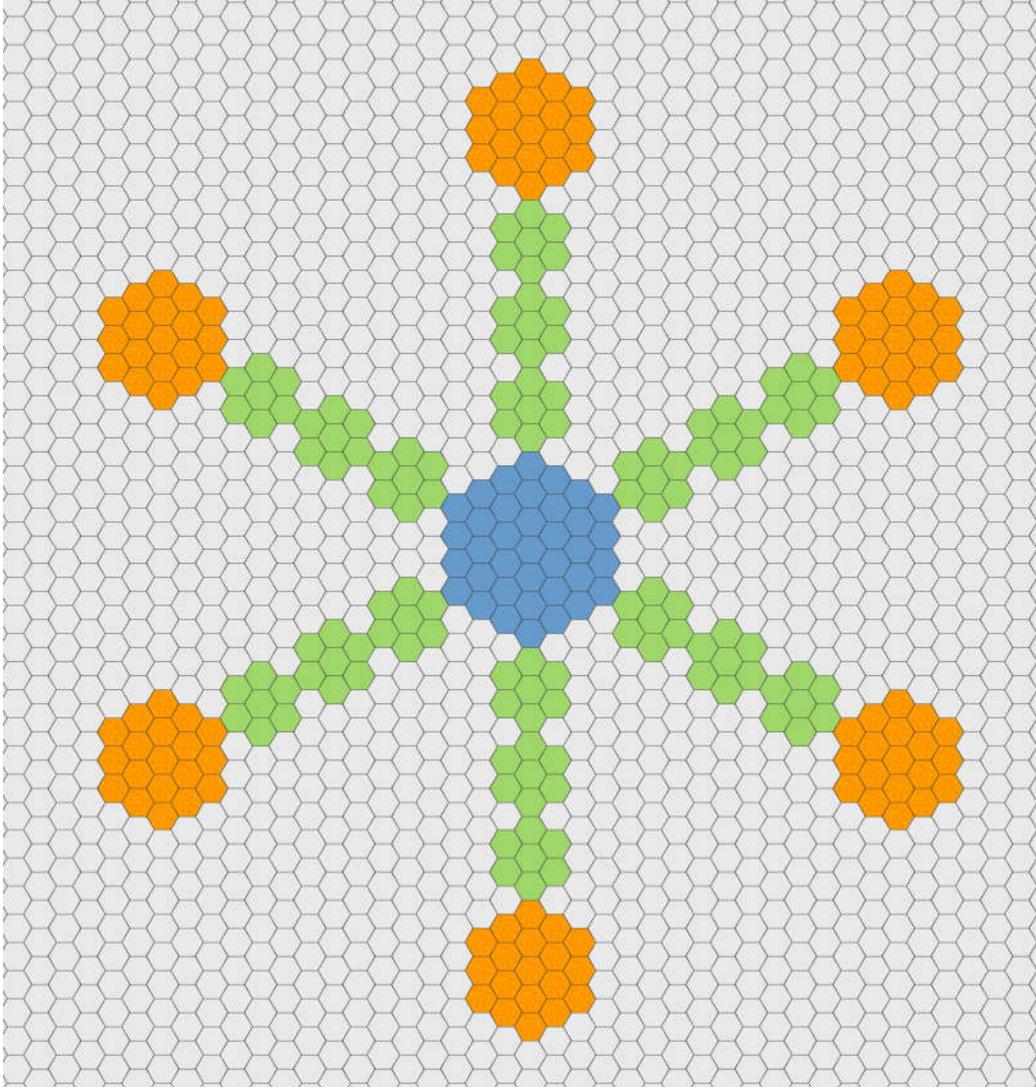
Two players can agree to a trade/transfer of resources/units. When their tiles+ are in contact with each other (with available eligible* units), the resources/units will be moved from one tile to another. (+ - trades/transfers may be tile specific or may be allowed on ANY tile of a given player. Players sometimes wish to specify the tile involved in a transfer.) (* - units in proximity to enemy units are not eligible for transfer, and immobile units (e.g. factories) are not typically eligible for transfer.)

Pipeline Tiles

Typically transfers occur simply between two tiles, perhaps one of the tiles was used to transport the goodies from a distant producer tile. But an intriguing possibility is for two or more chained adjacent tiles setting up a transfer pipeline from a large producer to a distant recipient. One could imagine producer transferring to tile 1, which (next turn) transfers to tile 2, then to tile 3, and ultimately to a recipient tile engaged in heavy combat that needs supply from remote sources.



In the above picture, the supply tile (blue) to the left is linked by multiple pipeline tiles to the recipient tile (orange). Conceivably the orange tile is involved in defending the blue tile from invaders (coming from the right). Also possible that both tiles are producers - blue tile is producing iron, orange tile is producing wood - and the bidirectional pipeline allows them to efficiently transfer their complementary resources or units.



In another pipeline variation, six orange producers are connected through green pipeline tiles to a central blue producer or storage tile. One can imagine how even rather complex products requiring multiple inputs could be efficiently produced with such a cooperative arrangement, and how such a vital production cluster would be supremely valuable to an alliance of players who would defend it vigorously. Presumably numerous attack and defense tiles would be clustered around this area for its protection, along with numerous transport tiles used to carry resources/units to distant allies. None of these configurations are a "standard" part of the fluid mosaic game; they

would be organized and constructed by players using their own innovation to create the best winning strategies. We design the building blocks, the players design their worlds (like a Lego set for creating empires).

Is Fluid Mosaic Terrain “Realistic”?

No. Land does not float upon water. If reality was our criterion for entertainment, we would not go to movies, read novels, or watch “reality television”. We play games to escape reality and live in a world of imagination and creativity.

In a “perfect” world, we would gather four or five of our best friends together at the same time and place to play a serious tactical or strategic game (using fixed terrain) for a few hours. But even with the best of friends, having maximal flexibility in their jobs and family lives, such simultaneous availability is vanishingly rare.

If we are to play a serious tactical or strategic multiplayer game in the real world, the game must be as fluid as player availability. By sacrificing the reality of fixed terrain, a continuous game can allow players to enter and leave freely, when they have time. This provides many potential players, and multiple arenas maximize the chance of finding friends with similar size and skill.

We give up the possibility of entering as the Normandie province of France and finding all of our friends in neighboring provinces ready to play with us. But that possibility never existed because of fixed terrain limitations. Instead, we can enter the game with our French empire (province) as it was when we left, and easily move to engage with our best friends and enemies for as long as we remain in the game.

Although the global fluid map is not as we left it, the map is sensible and relevant to the current play of the game since it is designed collectively by the players.

Viscous Fluid (Limits of Fluidity)

It is easy to be caught up in the fluid idea, thinking that tiles are peacefully floating about in the sea. This is true in a single player game, but not in a multiplayer game, where tiles bump up against other tiles. It is better to view the terrain as flexible (allowing the insertion of entering players) and self sealing (closing gaps from leaving players). The composition of the map is collectively created and renegotiated by the interaction of players, therefore as fluid as the player relationships.

Players will create their own strategic objectives, tactical strongpoints and supply lines. The game does not need specific rules for encirclement and unit annihilation. A tile whose supply line is interrupted (or its supplier destroyed) loses those supplies, impairing its ability to function or replenish reserves. Consequences are the result of game play, not arbitrary rules.

Some places on the map are preferred because they are closer to supply. Others are avoided because of their danger (or attractive for the same reason). Who decides which places are good and bad? The players - and the changing map reflects these changing decisions.

Maintaining Arena Size/Skill Limits

Players entering an arena must meet its requirements, but after playing for a while, could change in size or skill rating so that they no longer qualify. An alternative to ejecting them unceremoniously from the

arena (upon reaching a size limit) would be to set a time limit for the arena. This would prevent a player from growing to huge size and overstaying his welcome in an arena intended for smaller players.

This Cinderella* effect could be a wholesome part of the game, like a clock in a sporting contest. A player with an expiring clock would be forced to disengage from opponents to avoid the “leaving in the midst” penalty. Other players would recognize a large player with this vulnerability and might close on him to prevent his leaving easily. (* Cinderella’s fancy coach turned into a pumpkin when the clock struck twelve and she was forced to flee the ball.)

Defining a Fluid Mosaic Game (Database driven)

Multiplayer games derive much of their complexity from the players and their interaction, and this is even more true of FM games, in which even the game map is designed by the players. Players build their own empires, create their own trading relationships and alliances, develop their own means of attack and defense.

FM designers specify the data for available units and terrain, and must carefully consider the (sometimes complex) supply relationships. Care must be taken to accurately set the relative value of units so that the relative size (“weight” takes into account the relative value of the units and terrain, not merely the number) of player empires can be compared and stratified into appropriate arenas.

Creating stratified arenas requires experimentation and balancing. Many games will probably use a mix of lower level arenas stratified on size/weight or skill as well as arenas with a wider range of players who may use their freedom of association to create arenas with their own

character based on style of play (e.g. production/building vs. combat orientation).

Of course, programming cannot be entirely avoided. The code to handle each class of movement and each class of attack will need to be written on the FMEngine side, and corresponding code handling its animation will be required on the client side. Code handling communications and trade will need to be written, although much of this code will be common between many different FM games.

The code handling movement/propulsion of Tiles must be written on FMEngine, and probably little code on FMClient side for this, since (for simplicity) units will move as if the land is fixed in the current position. (This is reasonable since the terrain will move much more slowly than the units.)

Each different class of arenas (which will often vary by their zones and styles of deployment) will need specialized code, although this is probably shared among numerous games.

But once this infrastructure is built, the dream is that a new game can be created by specifying available units, each with allowed commands, movement and attack factors, production chains, team restrictions, and supply and command parameters specific to teams. Victory conditions, deployment styles and other arena parameters could all be defined by the database and not game specific code.

Analog and Variations – Russian Front Example

No game design can provide an “accurate” depiction of reality. Even so, game play should seem rational and familiar based on a player’s experience with prior games and even history. In this context, let us consider how Fluid Mosaic Terrain can enable a large strategic game. We will imagine how a second world war era game might present itself in the Fluid Mosaic model.

Sheer size draws our attention to the Russian front, with a battle line over a thousand miles, and several hundred divisions. The distances stretched supply lines to their limits and allowed great spearheads and encirclements. Armored, motorized units and aircraft transformed the static fronts of the Great War into the dynamic contest of breakthrough and encirclement.

This epic struggle unfolded on the fixed terrain of the Russian front. At first glance, it seems that fluid terrain cannot be suitable. Two powerful factors work to our advantage. The first is that while the terrain was fixed, this conflict and the units involved were highly fluid. There was enormous turnover of units on both sides, through combat attrition, encirclement and replacement. Accomplishing much of this turnover through shift and movement of fluid mosaic tiles is much less disruptive than might be expected. We can illustrate a surprising level of similarity by considering the encirclement and subsequent annihilation or capture of an army using fixed terrain. The army and its units are eliminated from the line. In the case of fluid mosaic terrain, the encircled army might also be annihilated or captured, but the army might also be removed by its player deciding to remove the tile (and its army) suddenly from the game (in disgust). Even this "unrealistic" action results in the army being removed, and creating a gap in the line. The

gap can be relatively quickly filled by movement of nearby tiles, analogous to nearby units maneuvering to fill the void in a fixed terrain game.

The second important factor is that fluid mosaic terrain is only relatively fluid (compared to fixed terrain), and less fluid than one might fear. FMT is a mosaic, after all, with relational positions between the tiles that are designed and desired by the players themselves. A player chose to be in his current position because he thought it is better than other positions – probably a function of trade, offensive and defensive factors. Players do not want to move their tiles without good reason.

In addition, although players have the ability to leave the game, we have previously discussed the penalty for leaving “in the midst”. Players are discouraged from leaving without good reason when adjacent to others, making the mosaic more stable than might be expected.

One source of fluidity is unavoidable, derived from the true multiplayer nature of the game. Since each player controls his own empire, a game can have hundreds of players acting in their own individual interest. This is actually a better approximation of reality than most “multiplayer” games, which give the players absolute control over many units. In real world combat, many units break and run after relatively modest losses, adding to the unpredictable nature of war. The tendency of players to act on their own makes the game more interesting.

An interesting variation in the fluid mosaic game is the presence of fluid gaps between player tiles that prevent true continuous lines. At first glance this seems a major difference yet even in the real world there were meaningful gaps in the strength of the line, and both sides were continuously probing for information of enemy strength and movements, often attacking into the enemy gaps. We cannot know in detail how

these differences will play out, but believe this variation may not be as disruptive as it first seems. Our intuition is that players will discover and attempt to exploit fluid gaps in the line, only to find their opponents moving their tiles to close those gaps. A close analog occurs with the way units are moved to fill an unoccupied area in fixed terrain.

Analogs and Variations – Pacific Theater Example

The Pacific theater of the second world war is also worthy of consideration, since it differs so dramatically from the Russian front. Is FMT suitable for a game based on this theater? We think it is.

The Pacific had relatively sparse units and huge distances between the islands. The large spaces between the islands create great unknown areas requiring reconnaissance, and emphasize the importance of seaborne aircraft for movement and intelligence. FMT is quite suitable for the Pacific theater, with the added bonus that players can move their empires to be closer to friends and foes.

Our discussion of FMT's suitability for world war based games does not imply that these are the best games for FMT. In fact, the best FMT games are simpler and more abstract. Our point is that a system able to handle a highly complex game such as a large scale world war game is robust and flexible enough for simpler applications.

The Recombinant Nature of Fluid Mosaic Terrain

Our genetic code is recombinant, using a shuffling of the genetic deck and a mixing of proven traits to provide adaptability and flexibility for the new organism.

There is analogous flexibility and recombination in the fluid mosaic model, intended to allow addition and removal of players without disrupting the ongoing game.

A deck of cards is a useful analogy for this model – two cards (or players) in the deck may be of similar strength but none are identical. Adding a card to the deck does change it, but does not alter the positional relationship or character of other cards in the deck. Removing a card causes a similar modest change.

Many fixed terrain games create variability through random numbers, and fluid mosaic games can do the same. But more intrigue and variability results from the player created maps and the relationships and adaptive tactics between the players. We believe this provides a rich source of game play not seen in fixed models.

Fluid Mosaic Games are like Child's Play

Young children play in an unstructured way, using a few toys, negotiating their own roles and their own rules, improvising and building their own castles, with intensely social interaction.

Unlike traditional fixed terrain games, Fluid Mosaic games have no predesigned maps of the world (which implicitly direct or dictate much of game play), and the lack of fixed structure and tactics allow players to improvise and adapt to their changing environment. Above all, Fluid Mosaic play is social play, like the play of children.

In meaningful respects, fixed terrain games are structured like chess, dictating style. Fluid Mosaic games have relatively few rules, relying on interaction between the players for their richness and emotional involvement, like poker.

MICROMOVES and Animation

FM games are often relatively complex, with meaningful interaction including trade and coordination with allies, and each turn will likely take 60 seconds (some much longer).

Even though each unit will execute a single order each turn, many orders will result in multiple “micromoves” . A unit that can move up to 4 hexes per turn would attempt to move just one hex multiple times in a turn, sometimes being blocked by other units. An artillery unit might fire at up to 6-8 targets in a turn, each one in a micromove, perhaps only start firing in mid turn as a target moves into range.

The number of micromoves per turn would vary by game, but 6-8 would allow decent animation (keeping in mind that # of micromoves would increase bandwidth requirements on FMServer/FMEngine).

Crowdsourcing Server Computation

Although computational costs of Fluid Mosaic Games are relatively modest, as N grows large, it is natural to wonder whether the server burden can be distributed to client machines.

The obvious answer is that any computation or data handling on a client machine is subject to (the horrors of) cheating which destroys integrity of the game. This is certainly true if a single client machine is trusted for the calculations.

However, it seems potentially practical to distribute the very same computing to multiple client machines, having all of them do the calculations and return their detailed checksums to a trusted server that

would compare them. If ALL of the results had matching checksums, the results might be considered reliable* and published to the clients. (* - an intriguing variation is that all of the results could match if ALL of the clients were cheating with precisely the same method. While it could be argued that they could not be gaining an advantage against each other, as they were all cheating in exactly the same way, they could be gaining advantage against players not presently in the game - so this possibility would need to be detected and avoided.)

A more subtle cheating variation on the client side would have the cheater performing all calculations flawlessly, yet making the game data (in its entirety) available to one or more of the players. {Under usual circumstances, a player sees only a subset of the data in the entire game, limited by sighting and proximity. In addition, some data related to resources/orders/production are made available only to the player himself, and knowing intimate data from inside another player's empire could be a significant advantage.} (In principle, one could try to distribute computing only to clients not in the same arena, so that they would not be given data related to their own game, but it would be hard to guarantee that they were uninterested in data from other arenas.)

For now, despite a level of curiosity, we believe that distributing computing and data (in full) to client machines is vulnerable to some attacks we can anticipate, others we cannot.

Implementing Fluid Mosaic Terrain (The Horror!)

At first glance, Fluid Mosaic seems so bizarre and unusual that the prospect of implementation is scary. Moving land masses! What does that mean for units - moving, attacking, defending, producing? Not nearly as much as it seems.

The solution should be as simple as possible, but not simpler. **Let's keep everything the same, when we can.**

Let's start with our ordinary map, composed of ordinary positional elements (hexes, squares, etc.). Some hexes are land, others are sea. Some land hexes have structures built on them. Player scrolls through the map, reviewing his units, examining what he knows about enemy territory and units, communicates with other players.

Units are given orders to move, attack, defend, produce. Units are created and deployed, on land or sea hexes. Orders are executed, combat is resolved, units are damaged or destroyed. Units retreat from combat.

All of this is very familiar - ordinary map, ordinary units, ordinary orders, order execution, combat resolution, production and deployment.

Whatever happened to all that fluid mosaic stuff? The answer is, nothing, during the ordinary course of the game. Familiar game phases and style of interaction with units and other players remains largely the same. No reason to fix familiar things that work well.

A separate **Fluid Phase** occurs at the beginning or end of each turn, in which land masses (tiles) may move. It does not occur during the ordinary phases, disrupting a player's expectation of how combat and movement work. Fluid Phase occurs on the FMServer. Each (land) hex may be part of a tile - the tile number is stored with the hex. Each tile has potential movement. If movement in a particular direction is scheduled for this Tile, FMServer checks to see if that movement is allowed (e.g. movement is not blocked by another tile). If allowed, the tile (and all of its hexes) are moved one hex in that direction. Any units associated with the tile hexes are also automatically shifted so they remain with the same land hex. Skipping over a few annoying details

for clarity, that's basically the end of the story for Fluid Phase.

A couple other exceptions we must consider, including placing a tile onto the map (typically when a player is entering the map). An open area needs to be found on the map, generally in the deployment area for new players of a specific team (tiles may not overlap). The hexes of the incoming tile are placed onto (previously) sea hexes on the map.

When a tile is removed (typically when a player is leaving the map), the hexes of the tile (and their units) are copied to storage (typically to a rectangular array of suitable size for storing the tile) and the hexes in the map are set back to sea hexes.

Some fluid games allow direct manipulation of tiles, including merging tiles, modifying their size/contours, etc. However, these operations are typically performed outside of the usual map operations, and therefore do not directly affect our handling of the game map.

Truncated ...
