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Multiphase Pairs Tournaments

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Contents

Abstract

Organizing large bridge pairs tournaments involves many technical decisions that can make the difference between a good or bad experience for players and that may affect the bridge quality of an event.

In section 1 we will deal with the structure of the tournament and the corresponding movements needed. In 1.3 we will describe in details a movement based on 5 tables Mitchell that is a very good candidate for any large pairs tournament.

In section 2 we will enter the ground of phase changes, dealing with carryovers and with the need of allowing pairs to join a tournament at a later stage.

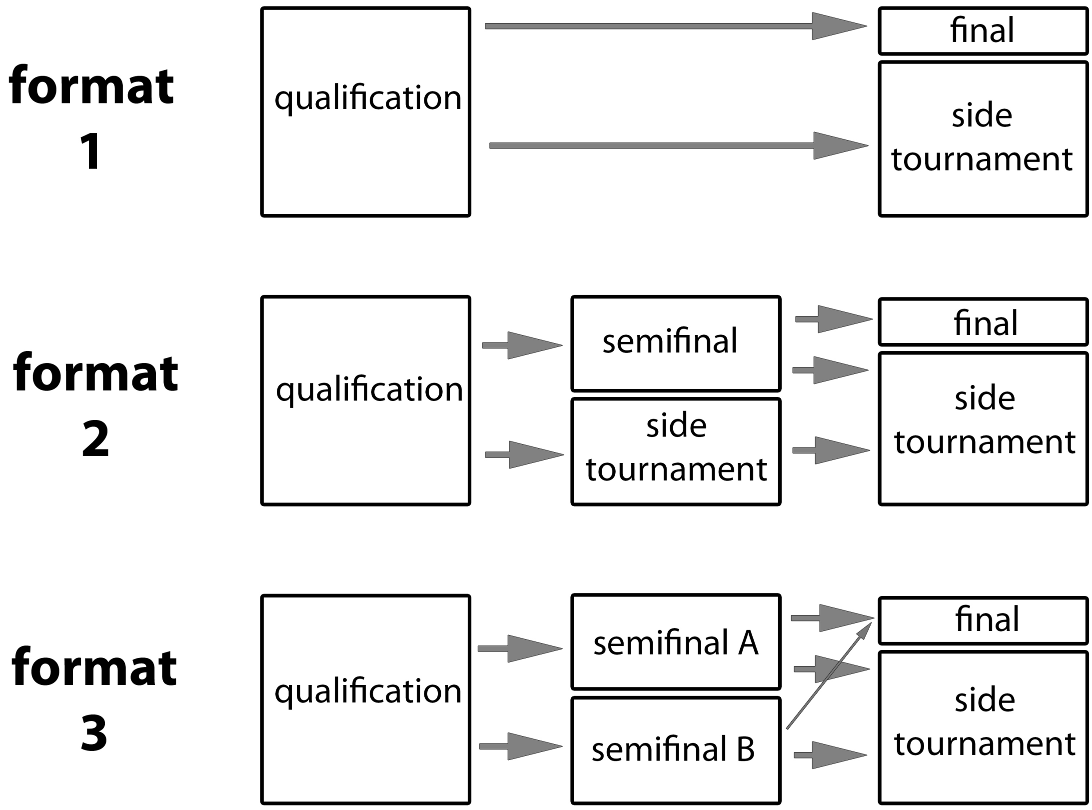
1 Format and movements

1.1 Tournament structure

Depending on the expected number of participants, a tournament structure should be prepared. It is quite appreciated by the players to know as much as possible about the way in which the tournament will develop[1].

[1]t is advisable to indicate numbers out of which the organization may change the format

The main decision to be taken is how many phases the tournament will consist of, depending on the number of expected participants and the number of days of play. The three most common formats are described in the sketch below.



The first format is to be used when dealing with 2-3 days tournaments or when there has been a previous selection that ensures a good minimum bridge level.

The choice between the last two solutions is much more difficult; first of all some statistics: since 2002 in the open pairs championships (European and World), format 2 has been used 4 times (Montréal 2002, Verona 2006, Philadelphia 2010 and Oostende 2013) and format 3 all the rest (7, Menton 2003, Tenerife 2005, Antalya 2007, San Remo 2009, Poznan 2011, Sanya 2014, Tromsø 2015). In all these 7 events, no medal has been won by a pair coming from semifinal B[2]. A computer simulation[3] shows that, in a qualification lasting 100 boards, a pair that normally averages 60% has less that 0.0006 chances to be under average. B semifinal has then very little chance to give a second chance to a favourite whilst it surely brings to the final a random factor that may alter the result (B semifinalist ranking in the final averages in the bottom third).

On the other hand, format 3 has two important facts in its favour: first, all pairs continue to play in the semifinal thus creating much fewer logistical problems (event too short + need of an early alternative tournament), second it gives players the psychological feeling of having a second chance, a fact that shouldn't be ignored in large events. Willing to use format 3, it is recommended to play a shorter qualification and a longer semifinal thus giving to the B semifinal repechage the role of recovering qualification inaccuracy.

[2]In the 1st IMSA games in Beijing, the Juniors Pairs was won by a pair coming from semifinal B

[3]running over one million loops

1.2 Movements

The choice of a movement depends quite a lot on logistics: sizes of playing areas, distance between tables, duplication capability and scoring systems are some of the factors to be taken into account. The organization should strive for barometer movements, that are so good from the (bridge) security and showing points of view. Unfortunately they are duplicationwise very demanding and unplayable in crowded rooms, thus creating the need of an alternative when they are not usable.

Unless differently stated, every movement in this text will have rounds of two boards, since with one board per round it is almost impossible to respect time limits and with three or more boards we are reducing the number of opponents that are already a too low number compared with the size of the field[4].

The following conditions should be verified by a movement in order to be useful for large tournaments:

A - adaptability to all numbers
B - easily understandable by players

other conditions that are welcome:

C - every pair plays every deal (except byes)
D - session time neither too short nor too long
E - flexibility to sudden changes of numbers

Condition B shouldn't be underestimated: if every section of a large tournament has its special movement that requires guidecards or tablecards, the attention of directors has to be focused on this aspect thus creating big issues whenever they have to poll players or decide on facts for a ruling. Because of this, Mitchell sections should be used whenever possible since this is a movement (and probably the only one) that players can follow without any assistance.

Let's first analyze what can be done using Mitchells only: due to condition A, not all sections can have the same size and so some Mitchell have to be curtailed or have to be a skip Mitchell without revenge round (thus losing condition C). Since having too different sizes implies more deals played only by a part of the field, the best choice for the section sizes are two consecutive numbers a and $a+1$. Since even Mitchells of size s can play only $s-1$ rounds[5] (without revenge round) the best choice of a is an odd number. These are then the most common solutions (trying to satisfy condition D):

- $m(7) + sm(8)$: Mitchell of 7 tables and skip Mitchell of 8 tables
- $m(9) + sm(10)$: Mitchell of 9 tables and skip Mitchell of 10 tables
- $m(11) + sm(12)$: Mitchell of 11 tables and skip Mitchell of 12 tables
- $m(13) + sm(14)$: Mitchell of 13 tables and skip Mitchell of 14 tables

[4] if the field is small enough to allow a round robin, rounds of more than two boards are welcome, since they reduce the time lost in moving from one table to another and they create a much more relaxed atmosphere

[5] only standard Mitchells are taken into account here, since shared relay Mitchells (a.k.a. bye-stand Mitchells) require twice as many sets of boards, thus making them less appealing

Is condition A satisfied? NO! ... or better ... it depends on the attendance: if you expect at least 100 tables you can easily go with 5s,7s or 9s, you are borderline with 11s and you have to cross the 13s solution out.

Which is the least number of tables that ensure the usability of each solution? There is a formula[6] that comes to help: for $m(a) + sm(a+1)$ you need at least

$$a^2 - a$$

tables. If your expected attendance is near to this limit, you'd better go for a different solution.

1.3 The Polish movement

Since the loss of condition C is very heavy[7], we need to introduce one or more section movements trying to use them in the possible number of sections - one[8] (that we will call *tail*). For reasons related to duplication, the base movement (to be used in all non-tail sections) has to be a Mitchell $m(a)$, a being an odd number.

Let's see which are the possible tails for every choice of a:

tables	possible tails
5	3,4,6,7
7	4,5,6,8,9,10
9	5,6,7,8,10,11,12,13
11	6,7,8,9,10,12,13,14,15,16
13	7,8,9,10,11,12,14,15,16,17,18,19

The smallest tail related to $m(a)$ has $\frac{a+1}{2}$ tables, why? This is the least size that allows an Howell movement with a opponents; in a smaller tail there is no movement of a rounds without rematches. The largest tail needed has $\frac{3a-1}{2}$ tables since with one more table (i.e. $\frac{3a+1}{2}$) it is possible to create two smaller sections due to the fact that $\frac{3a+1}{2} = \frac{a+1}{2} + a$. Each of these solutions is good enough to run a large tournament but there are several reason to lean toward a=5:

1) players, directors and scoring system have to deal with only 4 special movements (for 3,4,6,7 tables)
2) the play time is short, minimizing the chances of unauthorized informations being given+used[9]
3) 10 boards per session well fits 5 sessions in a day, whilst the other numbers are not that friendly[10]

[6] this is a special case of the Frobenius number, found for the first time by J. J. Sylvester in 1884

[7] to such a point that in some countries a movement worthy of the name cannot break that condition

[8] there are simple solutions with a tail of (at most) two sections that can be used when the scoring system has a limited choice of movements (Mitchells + Howells)

[9] with this short play time the organization may require players to sit for the entire duration of the session, possibly escorting whoever really needs a toilet break. This becomes more and more difficult as the session time increases

[10] 7 produces 3x14=42 (too few) or 4x14=56 (currently outside the standards, tough the limit is fixed at

This 5 tables system, that we will analyze in more detail, is known to the writer as *Polish movement* since Poland has been the first to have developed and used it in its national championships. Though it might appear at first sight that any 5 rounds movement for the possible tails would do the job, this is actually not true and the reason relies on the need to play, not just one, but multiple sessions without rematches.

To start understanding, let's suppose we have no tail: the movement for all the sessions can be created moving north/south and east/west lines of each Mitchell like they are pairs of a tournament with a number of rounds equal to the number of session of our original tournament. For example, this movement is quite common for two Mitchell sections and three sessions:

1st session	2nd session	3rd session
A NS	A NS	A NS
A EW	B NS	B EW
B NS	B EW	A EW
B EW	A EW	B NS

The main idea is to create movements for the tails that preserve the concept of line and to move lines across sessions exactly as we are used to do without tail.

1.3.1 3 and 4 tables tail

When the tail is of 3 tables, we use the normal H_3 Howell movement, with 1 stationary pair and 5 moving ones. The moving pairs will constitute a normal line and the stationary pair will be the *exceptional* line. With 4 tables we pick the $\frac{3}{4}$ Howell $H_{4,3}$ movement, with 3 stationary pairs and 5 moving ones. Again the moving pairs will form a normal line and the 3 stationary pairs will be the exceptional line.

1.3.2 6 and 7 tables tail

With 6 tables we use[11] the rAM_{5+1} movement (reverse appendix Mitchell 5+1 tables) that follows this table:

rnd	table1 NS EW BS	table2 NS EW BS	table3 NS EW BS	table4 NS EW BS	table5 NS EW BS	table6 NS EW BS
1	1 1 1	2 2 2	3 3 3	4 4 4	5 6 5	6 5 5
2	1 5 2	2 1 3	3 6 4	4 3 5	5 4 1	6 2 4
3	1 6 3	2 5 4	3 1 5	4 2 1	5 3 2	6 4 3
4	1 3 4	2 4 5	3 5 1	4 6 2	5 2 3	6 1 2
5	1 2 5	2 6 1	3 4 2	4 5 3	5 1 4	6 3 1

60 boards per day; 9 produces 3x18=54 (a little too high but reasonable); 11 is just impossible (2x22=44, too few); 13 is good (2x26=52) but have other drawbacks, length of session on top

[11]These are not the only movements that can be used (barometer movements for the tail may be simpler) but they have the advantage of needing only two board sets to be played

Since NS6 never plays EW6, we can define NS1-5 and EW1-5 as normal lines and NS6+EW6 as the exceptional line.

If the tail tables are 7, we go for[11] the rAM_{5+2} movement (reverse appendix Mitchell 5+2 tables) that follows this table:

rnd	table1	table2	table3	table4	table5	table6	table7
	NS EW BS	NS EW BS	NS EW BS	NS EW BS	NS EW BS	NS EW BS	NS EW BS
1	1 1 1	2 2 2	3 3 3	4 7 4	5 6 5	6 5 5	7 4 4
2	1 5 2	2 7 3	3 6 4	4 3 5	5 4 1	6 2 4	7 1 3
3	1 6 3	2 5 4	3 1 5	4 2 1	5 7 2	6 4 3	7 3 2
4	1 3 4	2 4 5	3 7 1	4 6 2	5 2 3	6 1 2	7 5 1
5	1 7 5	2 6 1	3 4 2	4 5 3	5 1 4	6 3 1	7 2 5

Since NS6,NS7,EW6,EW7 never play each other, we can define NS1-5 and EW1-5 as normal lines and NS6-7+EW6-7 as the exceptional line.

1.3.3 Moving lines

All these tail movements have one feature in common: they have an exceptional line whose members never play each other. This is crucial because we are not going to move pairs in the exceptional line across sessions and if they were playing in a session they would rematch in every other. Moreover, when two normal lines are present (6 and 7 tables) no play takes place between members of the same line; this allows a normal line to play twice (once as NS and once as EW) within this type of tail.

To complete the movement for all the sessions we just need to keep the exceptional line fixed and to move all the other lines with only few straightforward restrictions:

- no couple of lines can play each other twice
- no line can play twice in an Howell tail
- no line can play twice in the same compass direction inside an appendix tail

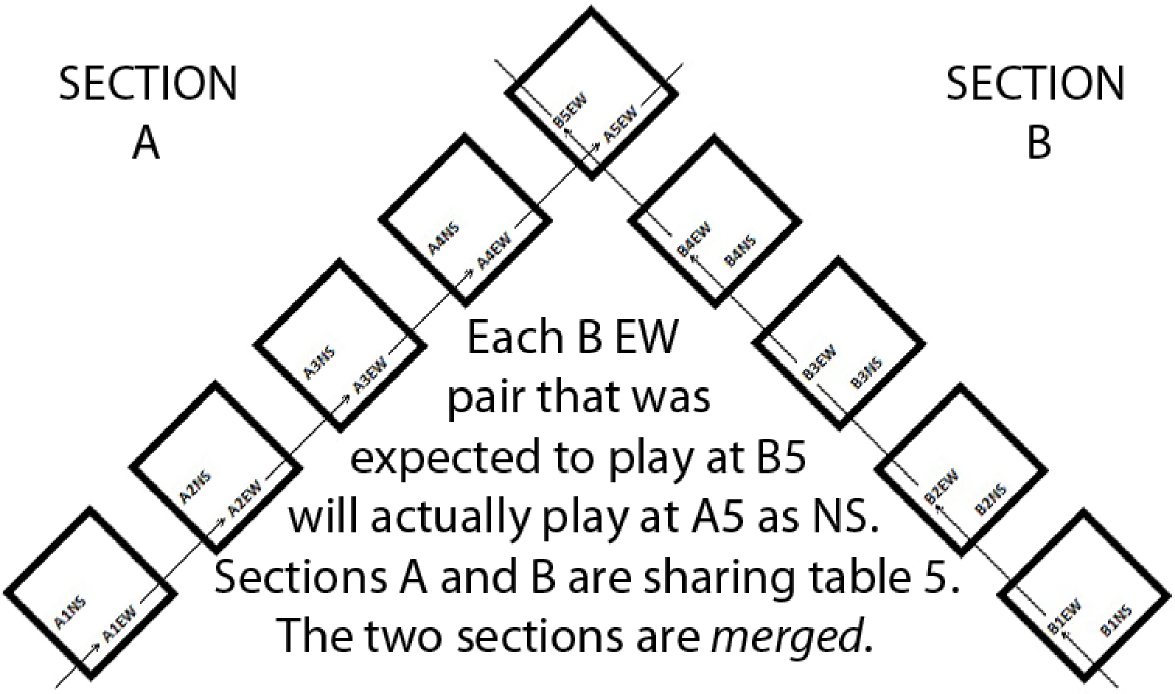
A sufficient (and necessary) condition for the lines movement to be possible is that the number of sessions is lesser than the number of lines (not counting the exceptional *appendix* line). A full movement can be prepared from the beginning and a balancing program could be used to increase equity[12]. This prepared movement can be changed to counter sudden drop outs, as we are going to see in the next paragraph.

1.3.4 Merging sections

If we look back at conditions stated in section 1.2 at page 3, we might notice that while the first four (A, B, C, D) has been used to build the idea of the Polish movement (that verifies them all), condition E never entered the picture. This is an unexpected gift that comes from the extreme flexibility of this system.

[12]Hans van Staveren has implemented in his software a balancing program developed by Peter Smulders that is very good for this purpose

As an example (that is indeed the most common case), let's suppose that the tournament already has a bye and a pair needs to withdraw for reasons of force majeure. Permuting members of the lines containing byes and switching compass directions if needed, we may suppose that bye1 is NS5 in some section (A) and bye2 is NS5 in some other section (B). Directors will then simply instruct each EW moving to B5 to play as NS in A5 for that round, coming back to the normal movement for the rest of the session. Since A5 and B5 have the same boards in every round, this change of movement is allowed and simply cancels the two byes. This procedure is known as section merging and its application is not limited to the Polish movement[13].



Directors need only to check that lines A EW and B EW have never played each other before; if this is the case a swap of lines is needed before merging. It is recommended for a scoring system that is willing to use the Polish movement to keep track of lines meeting along the sessions, in order to have a quick algorithm in such emergencies.

1.3.5 Seeding

Whenever the format is not a full round robin, the organization should put maximum effort to balance the tournament through a proper seeding. This is in general a difficult task due to the lack of information about some pairs and possible late registrations/withdrawals. In the Polish movement a seeding is needed to counter the lack of balance (as in whichever other movement with a low rounds/competitors ratio[14]). The field has to be split in five groups according to strength and each line have to contain one pair of each group (following a boustrophedon pattern to balance lines strength).

[13] it is applicable whenever the two byes (standing or moving) happen to play the same boards

[14] it is impossible to have a perfectly balanced movement in which a pair plays less then half of the opponents; the farther you go, the worse the balance will be. In a qualification stage of a large tournament is very common to play only a quarter of the field

Randomizing the order inside each line prevents a correlation issue (all good pairs would play each other in the same board) and it is then advised.

A new idea to further increase fairness (never done before and debatable) is to determine subsequent sessions starting positions using a delayed swiss type algorithm (based on the average result of a line). This ensures no rematches by definition and softens the potential inaccuracy in the lines creation. Since all lines are equally strong in theory, why not to use this method?

2 Changes of phase: carryovers and drop-ins

According to the format, a certain number of pairs will advance to a later phase (possibly divided in graded groups) depending on the ranking achieved in the previous stage[15]. For large tournaments it is almost mandatory to have changes of phase across the night to allow both scoring preparation and playing areas reshaping.

2.1 Carryovers

Each contestant will start the new phase with a score (the carryover) that may depend on the pair's performance and the organization has to inform players as early as possible about the way in which this is computed. To understand the principles behind the choice of the formula for the carryover we need some basic quantities to be defined:

- B_q and B_f are the number of boards played in the qualification[16] and the final[16] respectively
- T_q and T_f are the corresponding values for the top of one board
- $MP_q(x)$, $PP_q(x)$, $RK_q(x)$ are respectively the matchpoints, the percentage and the ranking of a pair x in the qualification
- $C(x)$ is the carryover to be assigned to the pair x (in terms of matchpoints in the final)

Since a longer qualification should give a larger carryover and a longer final should reduce the impact of it, a natural formula for the carryover is the following:

$$C(x) = B_q \cdot T_f \cdot V(x)$$

where $V(x)$ is still a function that the organization can choose that shouldn't depend on B_q, B_f, T_q, T_f. The important choice $V(x) = PP_q(x)$ is what is generally known as *full carryover* and $V(x) = \alpha \cdot PP_q(x)$ that brings to

$$C^{\alpha}_{full}(x) = \alpha \cdot B_q \cdot T_f \cdot PP_q(x)$$

is the *weighted carryover* corresponding to the weight $\alpha \geq 0$.

Since qualified pairs with high $RK(x)$ will have very similar percentages whilst top ranked pairs may have big percentage gaps compared to all the others, the organization should be careful in using full or weighted carryovers becuase this may give a too big

[15] A side tournament might be organized to let non-qualifiers play - this is advisable whenever the number of such pairs is sizeable

[16] throughout this section, the already played phase is called qualification and the phase to which the carryover has to be assigned is called final

advantage in the final: if the qualifying field is uneven, very high percentages are seldom the effect of a good performance and they reflect more the low quality of the opponents met. On the other hand, if the qualification contestants are of good quality (for example in the case of semifinals, where there has already been a selection) and in particular when the movement was a round robin a full or weighted carryover is sensible.

The alternative to full or weighted carryover is what is called *linear carryover* that comes from the choice[17] $V(x) = \frac{L-RK(x)}{L-1}$ where L is the last qualifying position. This can also be weighted choosing $V(x) = \beta \cdot \frac{L-RK(x)}{L-1}$, bringing to

$$C_{lin}^{\beta}(x) = \beta \cdot B_q \cdot T_f \cdot \frac{L - RK(x)}{L - 1}$$

that can be named *weighted linear carryover* with weight $\beta \geq 0$.

2.2 Comparison between carryover weights

Top ranked pairs in a not too short qualification rarely exceed 60% while the last qualified pair is normally somewhere around average. This means that, if a weighted carryover is used, the difference between the first and the last is given by

$$C_{full}^{\alpha}(first) - C_{full}^{\alpha}(last) = \alpha \cdot B_q \cdot T_f \cdot (PP_q(first) - PP_q(last)) \approx 0.1 \cdot \alpha \cdot B_q \cdot T_f$$

if instead a weighted linear carryover is used, the difference can be computed exactly:

$$C_{full}^{\alpha}(first) - C_{full}^{\alpha}(last) = \beta \cdot B_q \cdot T_f$$

Aiming to give the same maximum difference, the relation between the weights needs to be

$$\alpha = 10 \cdot \beta$$

In the past European and World Championships linear carryovers have been used extensively, with values of β between 0.02 and 0.04 that would correspond to 20%-40% full carryover. It would be interesting to analyze what would have happened, had these weights been higher.

2.3 Drop-ins

When large tournaments take place, it is quite common to have a teams event followed by a pairs one because this choice allows the organization to shorten the duration of the whole tournament keeping each event at his original length. Teams and pairs run parallel for a while and progressively those teams that get eliminated may form[18] one or more pairs that will *drop in* the pairs event as soon as possible. If the movement allows it, it is possible to drop in the middle of a qualification or a semifinal, but it is in general better to gather drop-ins at the beginning of a new phase.

[17]this choice may appear too complex, but it is actually the same as choosing $V(x) = L - RK(x)$ (very natural) since the scaling factor $L - 1$ can be thought as part of the β coefficient

[18]it is rather important that the organization asks the pairs willing to play to preregister even if they are still playing in the teams event. This allows a better handling of the process due to the knowledge of the numbers involved

Whenever a non zero carryover is assigned to qualifying pairs, also dropping pairs need to have one. To decide the value, we need to know some parameters of the event: the number T of qualified pairs, the number D of dropping in pairs and the number Q of the qualifying spots at the end of this phase. A fair value for the carryover is then given by the carryover of the qualified pair whose rank is (the nearest to):

$$x = \frac{Q \cdot T}{T + D}$$

The reason of the formula is that the average qualifying chance is $\frac{Q}{D+T}$ and the choice above splits the field exactly with this qualifying/total ratio. An example will clarify this point: $T = 90, D = 10$ and $Q = 50$. It would be wrong to assign the carryover of the 50th (incidentally below average[19]) because after the drop-ins we have 100 pairs out of which 50 qualify. The average is needed to qualify and this is the score of the 45th that is exactly the result of the formula. It worths noting that for small values of D (compared to T) the formula produces

$$x \approx Q$$

that explains why that value is so tempting (but wrong in general).

It is anyhow advisable to use mild carryovers when drop-ins are in the picture, in order to avoid too harsh complaints (sometimes from both sides of the fence).

2.4 Carryovers: yes or no?

The dilemma cannot be solved in general, but we will try to recognize patterns in which one solution is better than the other.
A carryover shouldn't be used:

- in a consolation event: every pair wants to have a second chance and a carryover (even the tiniest) would reduce the pleasure to play
- when the qualification is too short and the field is very uneven

A carryover is mandatory:

- if the previous phase movement was a round robin
- when the new phase is the continuation of the previous one

In all the other cases, the best approach is to use carryovers with low weights. This has the good point to give players the reason to play for something, thus avoiding random gifts due to careless behaviour.

[19]Though mathematically correct, an assignment of a below average carryover to a dropping pair will result in heavy complaints. This can only happen if the qualifying target is itself below average and in that case the organization may well decide to assign the average to all droppers